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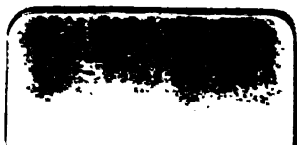
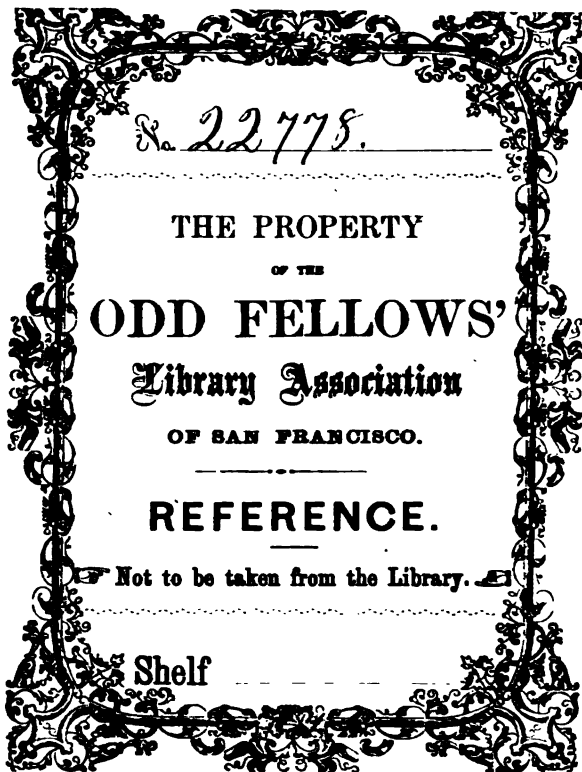
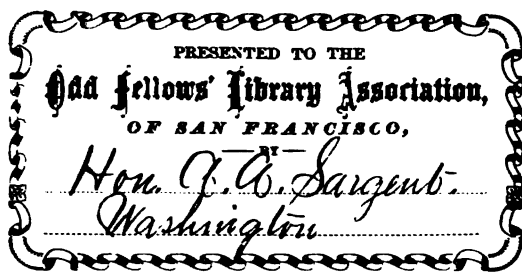
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42D CONGRESS, }
3d Session. }

HOUSE OF REPRESENTATIVES.

{ Ex. Doc
{ Part 2

REPORT
OF
THE SECRETARY OF WAR

BEING PART OF

THE MESSAGE AND DOCUMENTS

COMMUNICATED TO THE

TWO HOUSES OF CONGRESS

AT THE

BEGINNING OF THE THIRD SESSION OF THE FORTY-SECOND CONGRESS



VOLUME I.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1872.

REPORT

OF

THE SECRETARY OF WAR.

WAR DEPARTMENT, *November 1, 1872.*

Mr. PRESIDENT: A comparison of the expenditures of the War Department for the present fiscal year and the one immediately preceding, will show that the actual expenditures for the fiscal year ending June 30, 1871, were..... \$35, 799, 991 82
 For the year ending June 30, 1872..... 35, 372, 157 20

 Showing a reduction of 427, 834 62

The total estimate for military appropriations for the fiscal year ending June 30, 1874, is..... \$33, 801, 378 78,

The estimates of the Chief of Engineers are submitted separately as presented by that officer, namely :

Fortifications and other works of defense.....	\$3, 725, 000
River and harbor improvements.....	12, 302, 800
Public buildings and grounds and Washington Aqueduct .	612, 024
	<hr style="width: 20%; margin-left: auto; margin-right: 0;"/>
	16, 639, 824
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Since my last report there have been turned into the Treasury by surplus-fund warrant, balances of previous appropriations amounting in the aggregate to \$6,243,960.51. Had these balances been applicable for the use of the current or ensuing fiscal year, the estimates could have been reduced very materially, as, in the item of expenses for recruiting alone, the sum of \$300,000 was returned to the Treasury, being double the amount asked for under that head for the next fiscal year. An estimate of \$2,000,000 has been submitted to meet Treasury settlements in favor of States for expenses incurred for enrolling and subsisting troops called into the United States service during the late war, under the act of July 27, 1861, and \$100,000 for payment for horses lost or destroyed while in the military service of the General Government; these being the amounts required as reported by the Third Auditor, the officer charged by law with the examination and settlement of the accounts.

The reports of the General of the Army and of the division and

department commanders show that the various duties required of the Army have been performed with faithfulness. Desertions have decreased in number, the enlightened legislation in connection with the pay of the enlisted men having contributed greatly toward that end.

It has been found impossible, thus far, to reduce the force in the Southern States east of the Mississippi which were engaged in the War of the Rebellion. About one-sixth of the Army is still located there. It is to be hoped that an improved condition of affairs in that section may permit the withdrawal of a portion of the forces.

I renew the recommendation that the extra lieutenants now authorized by law to serve as regimental adjutants and quartermasters in the artillery, infantry, and cavalry regiments be discontinued, as vacancies occur in those grades. A yearly saving, with no injury to the service, of nearly \$160,000 would thus be effected.

Thorough inspections, especially in connection with those branches of the service having charge of disbursements, have been ordered, and the inspector will be held responsible for any defalcation or misapplication of the public money or property which may occur within the district assigned to him, that an active vigilance on his part might have detected.

Under the recent legislation placing the control of the Freedmen's Bureau under my immediate charge, the transfer of the records, accounts, claims, checks, Treasury certificates, and property from Howard University to a building near the War Department was completed about August 3d last, and regulations for the discovery, identification, and payment of the claimants for pay, bounty, prize money, or other moneys due to colored soldiers, sailors, or marines, or their legal representatives now residing or who may have resided in any State in which slavery existed in the year 1860, have been framed and put into execution.

The examination by the Bureau of Military Justice of the records of trials occurring in the different military departments, brings constantly before it what is felt to be a most serious defect in the administration of justice, and a most positive injury to the service; which is, the inequality of sentences adjudged by different courts for identical offenses. Desertion, for instance, receives in one department a punishment of two, three, four, and even five years' confinement at hard labor, while, in another, a sentence providing but for one year's imprisonment is deemed an ample expiation, and this in cases which, from the trial-records, appear to be, in all respects, deserving of the same proportion of punishment. Prisoners thus differently treated are often brought together, when, by comparison, the injustice wrought is made manifest to the sufferers, and the result naturally is to harden rather than reform the culprits.

Necessarily large discretion must be reposed in courts-martial, as to the measure of punishment required by the demands of justice, in a

vast number of cases brought before them; yet the opinion is entertained that the service would be greatly benefited, and its *morale* increased, by the adoption of a code providing specific penalties for well-defined offenses, with a minimum and maximum limitation to meet first offenses and the cases of persistent offenders. By the pursuit of this plan, it is believed the character of certainty of execution would attach to all sentences, adding largely to their corrective power, and relieving the Executive from the numerous applications for clemency that are now received.

The absence, too, of proper places of confinement for the enforcement of sentences is pregnant with deplorable results. It has led, through the necessity of the case, to the designation, by this Department, of the different State penitentiaries as military prisons, and prisoners guilty of purely military offenses are there compelled to associate with the vilest felons in the country, and subjected to all the humiliating and degrading disciplines of those institutions. Many men who might, under different treatment, again become useful soldiers, are thus yearly added to the criminal classes by the stigma of infamy attached to them, and the demoralizing influence of their prison associations. In connection with this subject, I would again call attention to the report of the board of officers who investigated the subject of military prisons in Canada, in the summer of 1871, which report was transmitted to Congress at its last session.

Under the existing laws there is no warrant or provision for the arrest by civilians of deserters from the Army, and when such arrests are made in consequence of awards offered by the military authorities, the civilian is compelled to assume all the responsibility of his act, and the expense and vexation which may arise from a suit. As a natural consequence, the deserter, in a measure, enjoys immunity from arrest by the citizen, and it is therefore recommended that legislation be had looking to the protection and defense by the United States of persons against whom suit shall be instituted for such arrest.

The expenditures for the service of the Quartermaster's Department during the year have been \$12,517,631.37.

The legislation which requires a separate account with each of the many different heads of appropriation to be kept by every disbursing officer, complicates accounts, increases the amount of capital lying idle to the credit of these officers, and makes larger appropriations necessary than under the old system, inasmuch as every disbursing officer needs a working balance on account of every appropriation, instead of a single working balance applicable to all appropriations.

The examination and settlement of accounts of the war, a work of vast labor, has at length been completed, and this business is now brought up to date. All accounts for money and property prior to 1871 have been examined and transmitted to the Treasury for final settlement. An improved and simplified system of rendering and settling money and

property accounts, which was introduced during the year, has greatly aided in this result.

The number of cavalry and artillery horses purchased during the year is estimated at	3, 277
Mules for the trains	209
The number of horses in service is	9, 720
of mules	8, 758

Much of the clothing and equipage left on hand at the close of the war has been used; a large quantity of it has suffered from the effects of time and decay, and has been sold. The changes in the uniform and dress of the Army, recommended by a board of officers convened with reference to that subject, were, with some modifications, approved, and the new clothing is being manufactured as rapidly as possible. The uniform adopted is believed to be a great improvement, and will, it is hoped, give general satisfaction in the Army.

The expenditures for clothing during the past year have been \$667,529.63, and the Quartermaster's Department has deposited in the Treasury, from sales of clothing and equipage during the year, \$1,843,831.40, which sum is not available for current use.

Transportation by railroad has cost	\$1, 300, 000 00
Of this \$800,857 was over the Pacific Railroads.	
Wagon transportation	1, 100, 000 00
Water transportation	626, 373 52
Stage transportation	48, 975 84
And the amount paid on account of purchase of transportation animals, purchase and repair of army and spring wagons, and carts, harness, &c.; hire of teamsters, wharfage, tolls, was	924, 650 64
Making a total of	4, 000, 000 00
exhausting the appropriation.	

The cost of construction and repair of military buildings has been \$385,925. Ninety-five new buildings have been erected at military posts, at a cost of \$240,853, and \$15,000 has been expended upon wharves.

The sum of \$100,000, set aside for the purpose of constructing a depot at San Antonio, Texas, has, under the operations of the law of May 18, 1872, been returned to the Treasury, and the work stopped. The city of San Antonio gave a site for this building, the title to which has been finally approved by the Attorney-General. It is recommended that the money be re-appropriated, and that the special authority required by that law for construction of a permanent depot building be given. Rents are costly, and there is much need of a central depot for the troops in that great State.

One hundred and thirty-eight thousand one hundred and thirty-two dollars and seventy-five cents have been collected from the indebted

Southern railroads, and unsettled accounts on file will probably increase this sum about \$230,000, making in all \$370,000, derived from these accounts during the year. The balance still due at the end of the year was \$4,734,442.43.

Under the law of July 4, 1864, for relief of loyal citizens in certain loyal districts, the Quartermaster-General has examined and transmitted to the accounting officers for settlement 665 claims for quartermaster's stores taken during the war, amounting, as allowed, to \$367,102.72; 274 others have been rejected, amounting to \$396,100.75. There are 10,351 claims under this law still on file, stated at \$6,857,006.56, but a large proportion of these are probably unjust.

The 74 national cemeteries now contain the remains of 317,962 persons. All but 16 of these cemeteries have been permanently inclosed, or are being inclosed under contracts now in operation. The Gettysburg cemetery has been transferred to the care of the War Department, and accepted under the resolution of Congress of July 14, 1870. The superintendents of national cemeteries have been classified with reference to the importance of their respective charges. There were 59 superintendents at the close of the year.

As legislation is needed in connection with the cemetery near the City of Mexico, purchased in accordance with the act of September 28, 1850, it is again recommended that a special act be passed placing this cemetery on the same basis with other cemeteries, with a duly appointed superintendent, and that a portion of the regular appropriation for national cemeteries be made applicable for use upon the one in question.

The condition of the tenure of the sites of military posts in Texas, to which the attention of Congress was called last year, remains unchanged. The land is private property, generally located by speculators at low rates, immediately after their occupation by troops. Extravagant rents are demanded, and as the law now forbids the War Department to purchase lands without the authority of Congress, the officers of the United States are in the position of trespassers, and the claims on account of these lands are unsettled. An act authorizing the Secretary of War to acquire title to sites already occupied, and to purchase such as may hereafter be required on this remote frontier, is needed to remedy this evil.

The sources and methods of supply for the Army have since the war been gradually brought into close conformity with the customary usages governing in commercial transactions.

A terrible conflagration having laid in ashes a large part of the city of Chicago, the Subsistence Department was, under telegraphic instructions to General P. H. Sheridan, called upon to furnish and distribute food to the sufferers by that calamity; accordingly supplies were hurried forward from Saint Louis and Cincinnati; but the munificent contributions by the people, for their suffering fellow-citizens, soon poured into

Chicago, from all quarters, so freely, that the sum of \$5,705.83 only was expended for this purpose by the Subsistence Department. The supplies sent to Chicago were, however, most opportunely there to meet a call for aid from the governor of Wisconsin for the sufferers by the forest fires, which swept over a portion of that State. For this purpose, Lieutenant-General Sheridan, under my authority, caused food, valued at \$30,836.11, to be issued to Governor Lucius Fairchild, "on condition that the State of Wisconsin will account for the stores at their value, if required to do so hereafter."

Subsistence supplies, valued at \$89,048.12, have been issued to Indians of the various tribes visiting the military posts on the frontier, or in their respective nations, no part of which amount is returned to the appropriation for the subsistence of the Army, and issues of subsistence stores to Indians have also been made to meet special emergencies to the amount of \$103,137.99.

It is recommended to set a future, but not distant day, as a limit after which claims upon the Subsistence Department under the act of July 4, 1864, shall not be presented to or received, and another day, not later than twelve months thereafter, for the termination of all action by that office on claims under this law.

The want of an assistant to each post-commissary is represented by the Commissary-General to be the greatest evil with which the Subsistence Department has now to contend in its important ministrations. To remedy it, I recommend that Congress authorize the appointment of as many commissary-sergeants as the service may require, not to exceed one for each military post or place of deposit of commissary stores, to be selected from such non-commissioned officers who shall have faithfully served as such for three years, and in the Army at least five years, whose duty it shall be, under the orders of the proper officers of the Subsistence Department, to assist in receiving, preserving, issuing, selling, and duly accounting for, under proper regulations, all stores pertaining to the Subsistence Department under their charge, and who shall receive for their services the pay and allowances of ordnance-sergeants. This would make a small addition to the enlisted force of the Army, but would lessen the total expense of the Government for its support, as by the constant care and skill of well-selected commissary-sergeants, the large quantities of stores now lost for want of such care and skill would be saved for issue.

The monthly reports of sick and wounded received during the year, represent an annual average mean strength of 24,101 white and 2,494 colored soldiers. Among the white troops the total number of cases of all kinds reported on the sick-list was 47,575; the total number of deaths reported was 367. Among the colored troops the total number of cases reported was 3,514; the number of deaths from all causes reported was 54.

The Army Medical Museum continues to receive valuable contribu-

tions, which are at once properly prepared, mounted, and their histories entered in the descriptive catalogue. The number of visitors to it during the year was over 17,000, many of whom were in search of information not attainable in any other quarter. Memoranda and photographs have been furnished, to assist in the decision of cases of applicants for the benefits of the various acts of Congress in relation to maimed and disabled soldiers and pensioners; and as the extent of this collection becomes better known, its usefulness is widely increased, not only by affording opportunities for study to the professional man, but also in promoting the ends of justice in supplying evidence for comparison in criminal trials.

I unite with the Surgeon-General in the recommendation that the necessary legislation be had to provide for the publication of an edition of one thousand of the catalogue and tables of the anatomical section of the Army Medical Museum.

The first part of the Medical and Surgical History of the War was in a state of sufficient forwardness to lay before Congress near the close of the last session. By the wording of the act making appropriation for the continuation and completion of this work, its distribution is still to be ordered by Congress. The report of the Medical Statistics of the Provost Marshal-General's Bureau is now in the hands of the Congressional Printer, and in process of being printed.

My previous reports have called the attention of Congress to the large number of vacancies at present—59—existing in the Medical Corps, and the injury to it and the service, resulting from the prohibition of appointments and promotions. It would require many years to fill the vacancies now existing, as the number of successful candidates rarely exceeds eight or ten in any one year. Numbers of the most desirable candidates, after waiting years for examination, have established themselves in civil practice. With the Army at its present standard, distributed as it now is, there is a constant and absolute necessity for a Medical Corps of the full number established by the act of Congress approved July 28, 1866.

The legislation of Congress at its last session has tended materially to encourage and improve the condition of the rank and file of the Army. The pay-bill carries the system of retained pay to those of all ranks, and no one can doubt the good effect of such a system.

The appropriation for the manufacture of arms for the current year (1872-73) is limited in its application to such system of breech-loading arm as may be selected by a board of officers, now in session. Should the selection be so long delayed as to cause an unexpended balance of the appropriation to remain on hand at the close of the fiscal year, its re-appropriation is recommended. The system being once adopted, arms sufficient to supply the Army and militia should be at once manufactured, and a large reserve should be accumulated year by year, for the exigencies of war, and, to this end, liberal appropriations will be required.

Reports from the field are all favorable to the use of revolvers using metallic cartridges.

Five thousand sets of new infantry equipments, combining the knapsack, haversack, canteen, cartridge-box, waist-belt, and the bayonet-sabbard into one system, have been made during the year, and issued to the troops for experimental trial. A sufficient sum is asked to supply the service with these equipments.

The board on heavy ordnance, authorized by the act of June 6, 1872, have made their report, and measures have been taken to carry out their recommendations. The procurement and trial of the guns recommended by them will probably consume the whole of the year 1873.

A moderate sum is estimated for the procurement of cast-iron smooth-bore guns and iron carriages for the fiscal year. Nearly 800 of such guns, besides 300 mortars, are still needed for our forts.

Such of the arsenals east of the Mississippi River as can be spared should be sold, and the proceeds applied to the establishment of a large arsenal of construction and repair on the Atlantic coast, and the erection of suitable depots for the storage of the powder and niter belonging to the Department. The means of rapid communication of modern times obviates the necessity of having an arsenal in almost every State of the Union, and the consolidation of several of them into one establishment would result in great economy to the Government, and promote efficiency. A proving and experimental ground for heavy ordnance is much required, and the purchase of a suitable site is recommended. The grounds at present used, at Old Point Comfort, Virginia, are inadequate to the wants of the Ordnance Department.

Suspension of the sale of certain arsenals has been directed until the opening of Congress, in order that the law requiring the sale may be so amended as to enable the Department to save the property from sacrifice in case of combinations of bidders. The act directed the sale of Apalachicola arsenal, but that property had previously been granted by Congress to the State of Florida. The provision directing its sale should be repealed.

Some plan for settling the long-disputed claims for royalty on the arms that have been altered at Springfield armory should be devised, and the attention of Congress is called to such legislative enactments as tend to deprive the Government of the inventive ingenuity of its officers and employes, by preventing them from receiving royalty or participating in profits derived from inventions made by them while in the United States service.

The Chief of Ordnance calls attention to the necessity for the repeal of the law prohibiting promotions and appointments in that corps. Congress by an act passed at its last session relieved the Corps of Engineers from the operation of the act approved March 3, 1869, and in my judgment it is now advisable that all of the staff corps of the Army,

affected by the law of March 3, 1869, should have the same privilege extended to them.

During the past year the Corps of Engineers has been engaged upon the works for the defense of our coasts; upon river and harbor improvements and the surveys for them, and for the protection of the navigable waters of the United States against deterioration, whether from bridging or other cause; upon the geodetic and hydrographic survey of the lakes; upon surveys for the defense of the coast; upon military surveys and reconnaissances in the interior; upon geographical and geological explorations; upon public buildings and grounds in the District of Columbia; upon the construction of light-houses; and upon the demarkation of the boundary between the United States and Great Britain.

The work upon our coast defenses and fortifications has been prosecuted with vigor, and already a large number of positions for guns and mortars of the largest calibers, to be mounted behind sand parapets, have been provided, while others are in an advanced state of construction. These works should be continued, as they are the basis of our harbor protections, and are essential for the efficacy of the accessory defenses, especially of torpedoes and channel obstructions, which form a part of our own system of defense.

The Battalion of Engineers, in its reduced organization, numbers 315 men, but retains its marked efficiency in drill and discipline, and furnishes the instruction to the cadets at the Military Academy in practical military engineering, while at Willet's Point it forms the school for the torpedo-defense of our harbors, and the guards and workmen for the distribution, care, and preservation of the bridge-trains, and engineer equipments of the Army. The appropriations asked for this depot and post are recommended to Congress, while the repeated recommendation of the Chief of Engineers, for the repeal of the seventh section of the act of July 13, 1866, taking from engineer soldiers the *per diem* granted to other troops, is approved.

The torpedo experiments, made under the immediate direction of Major H. L. Abbot, commanding engineer battalion, have been brought so far to satisfactory conclusion as to enable us to devise a plan of torpedo defense in connection with the fortifications, simple in its working, certain in its application, and effective in its results, while at the same time our own shipping will not be endangered. An estimate for providing means to apply the system to a few of the principal harbors is submitted in the annual estimate for fortifications.

The river and harbor works, and the many surveys annually directed to be made in extending the system of improvement, have been carried on with skill, energy, and economy. The increased security and facility to navigation which these works of improvement have afforded, though many of them are only partially completed, have saved to commerce many times the amount of the sum expended on the works; and the increase of commerce, with greater depth of channels, greater security

in their navigation, and the saving of time in their use, adds millions annually to the wealth of the country, and increases the resources of the Government. For further information respecting these improvements and surveys, reference may be made to the report of the Chief of Engineers, which contains a detailed account of the steps taken to carry out the provisions of the river and harbor bills, and the progress and condition of these works, as well as of the public buildings and grounds in Washington, and of the Washington Aqueduct, works which have been carried on in a highly creditable manner.

The river and harbor bill, approved June 10, 1872, appropriated the sum of \$145,000 for payment to the Green Bay and Mississippi Canal Company for so much of its property and rights of property in and to the line of water communication between the Wisconsin River and the mouth of the Fox River, as were reported by the Secretary of War to the House of Representatives on the 8th March, 1872, to be needed. In conformity with the requirements of the act referred to, the Green Bay and Mississippi Canal Company transferred the property to the United States, and the sum of \$145,000 was paid to the company on the 24th of September last.

The construction of the bridge across the Mississippi River at Rock Island has been completed, and the bridge will be immediately opened for railroad and wagon-road use.

In conformity to the requirements of the two acts relating to bridging the Mississippi River, the one approved April 1, 1872, the other approved June 4, 1872, the proper site for the bridge at La Crosse and vicinity has been determined.

The river and harbor bill approved June 10, 1872, directed the Secretary of War to report to Congress, at its next session, or sooner, if practicable, the condition of the canal at the Falls of the Ohio River and the provisions necessary to relieve the canal from incumbrance, with a view to such legislation as will render the same free to commerce at the earliest practicable period. This report will be completed in time to be submitted to Congress at its meeting in December.

The survey of the lakes has been conducted in a very satisfactory manner; the survey of Lake Superior having been completed, and that of Lake Michigan having been extended so far as to require probably but one more working season to complete it. The operations in other portions of the field of survey, comprising Lakes Erie, Ontario, and Champlain, and the Saint Lawrence River, have been equally successful, as have been the meteorological and lake-surface observations, which extend over the whole lake-region.

The geological exploration between the Sierra Nevada and eastern slope of the Rocky Mountains will probably be completed by the close of the present season for field operations. The results of this work are of the very highest value in the departments of geology, topography, and mining engineering. The exploration in Nevada, Utah, and Ari-

zona was continued until December of last year, when a preliminary report of the results, affording valuable information for mining as well as for military operations and to immigrants, was submitted to Congress and published. The field-work, which, in addition to the usual subjects of observation, comprises the careful determination of an astronomical base, was resumed this summer as soon as the appropriation was available.

In addition to these special works of exploration the officers of Engineers serving on the staff of the generals commanding divisions and departments have made important reconnaissances, such as that of the Upper Yellowstone River and that of the Uintah Mountains, and have made many contributions to the topography of the Territories of the United States.

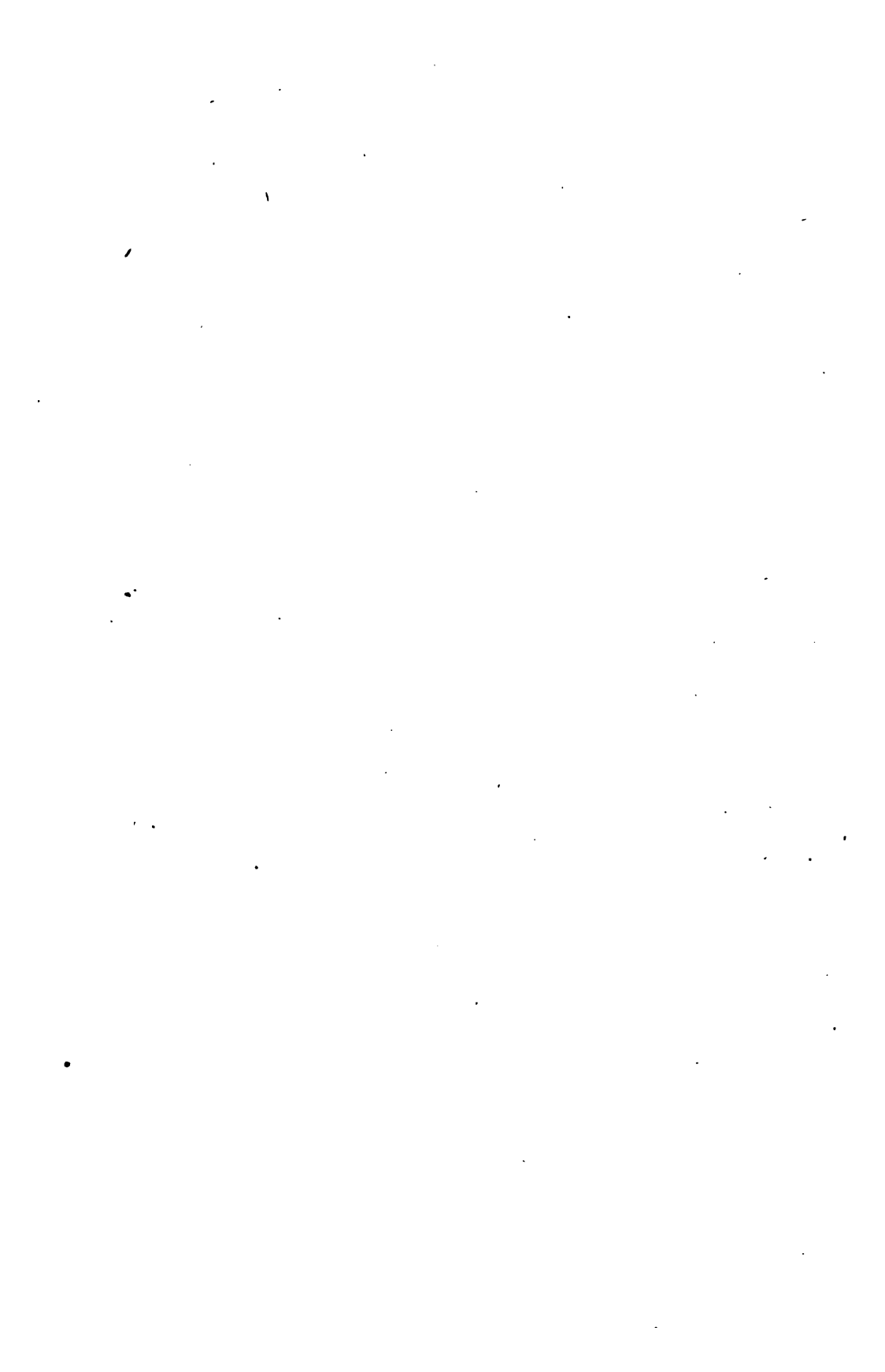
In compliance with the act approved March 19, 1872, authorizing the survey and marking of the boundary between the territory of the United States and the possessions of Great Britain from the Lake of the Woods to the summit of the Rocky Mountains, four officers of Engineers were detailed for that purpose and ordered to report to the Secretary of State for duty. The survey is now in progress.

The duties of the Signal Office in observations and reports for the benefit of commerce and agriculture have been continued throughout the year with gratifying success. Stations have been maintained at each of the principal lake, sea-port, and river cities. The display of bulletin reports, of reports at the river stations, giving the rise and fall of the principal rivers, of the large weather-maps showing, by changing symbols, the meteoric changes at the different reports; and finally, at designated stations, the exhibition of day or night signals, on occasions of supposed especial danger, has been regularly made. Since the date of the last annual report ten additional stations have been established within the United States.

A comparison of the tri-daily forecasts, or "probabilities" as they have been styled, with the meteoric condition afterward reported, and, so far as known, has given an average of 69 per cent. as verified up to November 1, 1871. Since that date, to the present time, (October 1, 1872,) the average of verifications has been $76\frac{3}{5}$ per cent.

The difficulty of telegraphic communication with the stations was greatest, and was most seriously felt during the months of July and August. It then not unfrequently happened that the most important and wide-spread of the press "probabilities," *i. e.*, those drawn at midnight from the midnight reports, were made in the absence of any current telegraphic information at that hour due from the observers west or south of the Alleghanies. It is on this section on which the office is most dependent for the intelligence which suggests the meteoric changes impending in the Eastern, Middle, and Southern States, and upon the lakes.

The practical results of this branch of the service, with all its errors



REPORT OF THE GENERAL OF THE ARMY.



REPORT
OF
THE GENERAL OF THE ARMY.

HEADQUARTERS OF THE ARMY,
Washington, D. C., November 1, 1872.

SIR: I have the honor to submit, herewith, a statement showing the organization of the Regular Army, and exhibiting the actual strength of the regiments and detachments that compose the present peace establishment, together with the stations occupied by them at the dates of the latest returns. According to this statement the actual force of enlisted men is 29,336, and of commissioned officers 2,104.

I also transmit, herewith, the annual reports of the division and department commanders, which cover the whole area of the United States, and give all the details necessary to understand the labors performed by the troops.

But few changes have occurred in the past year. Major-General G. G. Meade commands the Division of the Atlantic, composed of the Department of the Lakes, Brigadier-General P. St. George Cooke, and the Department of the East, Brigadier-General I. McDowell.

Lieutenant-General Sheridan commands the Division of the Missouri, embracing the four important Departments of Dakota, Major-General Hancock; Department of the Platte, Brigadier-General Ord; the Department of the Missouri, Brigadier-General Pope; and the Department of Texas, Brigadier-General Angur.

General Schofield commands the Division of the Pacific, embracing the Department of the Columbia, Brigadier-General Canby, the Department of California, and Department of Arizona, Lieutenant-Colonel Crook. General Schofield exercises an immediate command over the Department of California, in the absence of a separate and distinct commander.

Since the death of General Halleck, the President has not named any successor to the Military Division of the South, and the department commanders, Brigadier-General Terry and Colonel Emory, report direct to the Adjutant-General of the Army.

The reports of all these officers are so full and complete that they leave nothing for me but to submit them, with my hearty approval of the several recommendations therein.

I have the honor to be your obedient servant,

W. T. SHERMAN,
General.

Hon. W. W. BELKNAP,
Secretary of War.

Statement showing the organization of the Regular Army, compiled from returns received at the Adjutant-General's Office up to October 20, 1872.

FIRST REGIMENT OF CAVALRY.

Companies, &c.	Enlisted men present and absent.	Date of report.	Station.
Headquarters.....		Aug. 31, 1872	Benicia Barracks, California.
Non-commissioned, staff, & battalion.	18	do	Do.
A.....	62	do	Fort Whipple, Arizona Territory.
B.....	53	do	Fort Klamath, Oregon.
C.....	60	do	Camp McDermitt, Nevada.
D.....	73	do	Camp Lowell, Arizona Territory.
E.....	61	do	Fort Lapwai, Indian Territory.
F.....	61	do	Camp Warner, Oregon.
G.....	57	do	Camp Bidwell, California.
H.....	64	do	Camp Harney, Oregon.
I.....	65	do	Camp Verde, Arizona Territory.
K.....	62	do	Camp Halleck, Nevada.
L.....	62	do	Camp Apache, Arizona Territory.
M.....	24	do	Do.
	200		Recruits left Saint Louis depot, September 17, 1872.
	3		Recruits left Saint Louis depot, September 29, 1872.
Total.....	925		

SECOND REGIMENT OF CAVALRY.

Headquarters.....		Aug. 31, 1872	Fort Sanders, Wyoming Territory.
Non-commissioned, staff, & battalion.	20	do	Do.
A.....	70	do	Fort Fred Steele, Wyoming Territory.
B.....	72	do	Fort Bridger, Wyoming Territory.
C.....	70	do	Red Willow Creek, Nebraska.
D.....	53	do	Camp Douglas, Utah Territory.
E.....	66	do	Fort Laramie, Wyoming Territory.
F.....	43	do	Fort Ellis, Montana Territory.
G.....	43	do	Do.
H.....	56	do	Do.
I.....	62	do	Fort Sanders, Wyoming Territory.
K.....	69	do	Fort Laramie, Wyoming Territory.
L.....	51	do	Fort Ellis, Montana Territory.
M.....	70	do	Omaha Barracks, Nebraska.
	7		Unassigned recruits.
	50		Recruits left New York City, May 20, 1872.
	9		Recruits left Saint Louis depot, July 12, September 12, and October 1, 1872.
			150 recruits ordered, October 16, 1872.
Total.....	813		

THIRD REGIMENT OF CAVALRY.

Headquarters.....		Aug. 31, 1872	Fort McPherson, Nebraska.
Non-commissioned, staff, & battalion.	91	do	Do.
A.....	76	do	Sidney Barracks, Nebraska.
B.....	74	do	Fort McPherson, Nebraska.
C.....	78	do	Fort D. A. Russell, Wyoming Territory.
D.....	74	do	Do.
E.....	79	do	Fort Sanders, Wyoming Territory.
F.....	75	do	Fort McPherson, Nebraska.
G.....	74	do	Fort D. A. Russell, Wyoming Territory.
H.....	80	do	Do.
I.....	77	do	Fort McPherson, Nebraska.
K.....	72	do	Camp Red Willow, Nebraska.
L.....	67	do	Fort D. A. Russell, Wyoming Territory.
M.....	78	do	Fort McPherson, Nebraska.
			85 recruits ordered, October 16, 1872.
Total.....	925		

Statement showing the organization of the Regular Army, &c.—Continued.

FOURTH REGIMENT OF CAVALRY.

Companies, &c.	Enlisted men present and absent.	Date of report.	Station.
Headquarters		Aug. 31, 1872	Fort Richardson, Texas.
Non-commissioned, staff, & battalion.		do	Do.
A	20	June 30, 1872	Do.
B	53	Aug. 31, 1872	Do.
C	60	do	Do.
D	71	June 30, 1872	Fort Concho, Texas.
E	69	Aug. 31, 1872	Fort Richardson, Texas.
F	63	June 30, 1872	Fort Griffin, Texas.
G	64	Aug. 31, 1872	Fort Concho, Texas.
H	77	do	Fort Griffin, Texas.
I	74	do	Fort Concho, Texas.
J	56	do	Do.
K	73	do	Fort Richardson, Texas.
L	61	do	Fort Brown, Texas.
M	67	do	160 recruits left Saint Louis depot, May 29, 1872; 44 joined. Musicians left Saint Louis depot, October 1, 1872.
	116		
	4		
Total	833		

FIFTH REGIMENT OF CAVALRY.

Headquarters		Aug. 31, 1872	Camp McDowell, Arizona Territory.
Non-commissioned, staff, & battalion.		do	Do.
A	29	do	Camp Verde, Arizona Territory.
B	72	do	Camp McDowell, Arizona Territory.
C	75	do	Do.
D	74	do	Camp Bowie, Arizona Territory.
E	74	do	Camp Date Creek, Arizona Territory.
F	48	do	Camp Crittenden, Arizona Territory.
G	72	do	Camp McDowell, Arizona Territory.
H	74	do	Do.
I	68	do	Camp Grant, Arizona Territory.
J	70	do	Camp Hualpai, Arizona Territory.
K	74	do	Camp Grant, Arizona Territory.
L	70	do	Do.
M	22	do	201 recruits left Saint Louis depot, June 25, 1872; 179 joined.
	4	do	Recruits left Saint Louis depot, September 17, 1872.
	110	do	Recruits left Saint Louis depot, October 14, 1872.
Total	1,010		

SIXTH REGIMENT OF CAVALRY.

Headquarters		Aug. 31, 1872	Fort Hays, Kansas.
Non-commissioned, staff, & battalion.		do	Do.
A	24	do	Do.
B	76	do	Do.
C	80	do	Do.
D	82	do	Do.
E	78	do	Fort Wallace, Kansas.
F	80	do	Southeastern Kansas.
G	82	do	Fort Hays, Kansas.
H	82	do	Fort Dodge, Kansas.
I	79	do	Do.
J	50	do	Oxford, Mississippi.
K	52	do	Meridian, Mississippi.
L	79	do	Fort Hays, Kansas.
M	63	do	Fort Lyon, Colorado Territory.
	1	do	Unassigned recruit.
	39	do	104 recruits left Saint Louis depot, August 22, 1872; 65 joined.
	57	do	Recruits left Saint Louis depot, September 12, 1872.
	5	do	Recruits left Saint Louis depot, September 29, 1872.
Total	1,009		

Statement showing the organization of the Regular Army, &c.—Continued.

SEVENTH REGIMENT OF CAVALRY.

Companies, &c.	Enlisted men present and absent.	Date of report.	Station.
Headquarters		Aug. 31, 1872	Louisville, Kentucky.
Non-commissioned, staff, & battalion.	90	do	Do.
A	59	do	Elizabethtown, Kentucky.
B	64	do	Spartanburgh, Kentucky.
C	68	do	Charlotte, North Carolina.
D	56	do	Opelika, Alabama.
E	59	do	Unionville, South Carolina.
F	67	do	Louisville, Kentucky.
G	61	do	Laurensville, South Carolina.
H	69	do	Nashville, Tennessee.
I	65	do	Shelbyville, Kentucky.
K	58	do	Yorkville, South Carolina.
L	61	do	Do.
M	51	do	Unionville, South Carolina.
	4		7 recruits left Saint Louis depot, August 20, 1872; 3 joined.
	1		Musician left Saint Louis depot, September 29, 1872.
	1		Recruit left Saint Louis depot, October 13, 1872.
Total	764		

EIGHTH REGIMENT OF CAVALRY.

Headquarters		Aug. 31, 1872	Fort Union, New Mexico Territory.
Non-commissioned, staff, & battalion.	23	do	Do.
A	62	do	Fort Bayard, New Mexico Territory.
B	60	do	Fort Union, New Mexico Territory.
C	58	do	Do.
D	66	do	Fort Stanton, New Mexico Territory.
E	56	do	Fort Wingate, New Mexico Territory.
F	55	do	Fort Garland, Colorado Territory.
G	64	do	Fort Selden, New Mexico Territory.
H	51	do	Fort Tularosa, New Mexico Territory.
I	64	do	Fort Bayard, New Mexico Territory.
K	50	do	Fort Wingate, New Mexico Territory.
L	55	do	Fort Union, New Mexico Territory.
M	61	do	Do.
	37		107 recruits left Saint Louis depot, March 25, 1872; 70 joined.
	201		Recruits left Saint Louis depot, September 26, 1872.
Total	963		

NINTH REGIMENT OF CAVALRY.

Headquarters		Aug. 31, 1872	Fort Clark, Texas.
Non-commissioned, staff, & battalion.	20	do	Do.
A	56	do	Do.
B	34	do	Ringgold Barracks, Texas.
C	48	do	Fort Duncan, Texas.
D	58	do	Fort Clark, Texas.
E	51	do	Do.
F	52	do	Fort McKavett, Texas.
G	41	do	Fort Clark, Texas.
H	40	do	Fort Stockton, Texas.
I	45	do	Fort Davis, Texas.
K	48	do	Fort Bliss, Texas.
L	66	do	Fort McIntosh, Texas.
M	55	do	Fort McKavett, Texas.
	4		Recruits left Saint Louis depot, July 22, 1872.
	5		Recruits left Saint Louis depot, August 26, 1872.
	8		Recruits left Saint Louis depot, October 7, 1872.
	1		Recruit left Saint Louis depot, October 13, 1872.
Total	632		

Statement showing the organization of the Regular Army, &c.—Continued.

TENTH REGIMENT OF CAVALRY.

Companies, &c.	Enlisted men present and absent.	Date of report.	Station.
Headquarters.....		Aug. 31, 1872	Fort Sill, Indian Territory.
Non-commissioned, staff, & battalion.	19	do	Do.
A.....	40	do	Do.
B.....	42	do	Fort Gibson, Indian Territory.
C.....	61	do	Camp Supply, Indian Territory.
D.....	51	do	Do.
E.....	19	do	Fort Sill, Indian Territory.
F.....	57	do	Camp Supply, Indian Territory.
G.....	30	do	Fort Sill, Indian Territory.
H.....	39	do	Fort Gibson, Indian Territory.
I.....	24	do	Fort Sill, Indian Territory.
K.....	24	do	Do.
L.....	35	do	Do.
M.....	47	do	Do.
	25		Recruits left Saint Louis depot for companies C and F, August 30, 1872.
	178		Recruits left Saint Louis depot, October 4, 1872.
Total.....	691		

FIRST REGIMENT OF ARTILLERY.

Headquarters.....		Aug. 31, 1872	Fort Hamilton, New York Harbor.
Non-commissioned, staff, & battalion.	24	do	Do.
A.....	42	do	Fort Ontario, New York.
B.....	40	do	Fort Wadsworth, New York Harbor.
C.....	44	do	Fort Hamilton, New York Harbor.
D.....	52	do	Do.
E.....	46	do	Fort Wood, New York Harbor.
F.....	37	do	Madison Barracks, New York.
G.....	57	do	Fort Monroe, Virginia.
H.....	47	do	Fort Hamilton, New York Harbor.
I.....	38	do	Fort Wood, New York Harbor.
Light Battery K.....	65	do	Fort Hamilton, New York Harbor.
L.....	34	do	Fort Niagara, New York.
M.....	38	do	Plattsburgh Barracks, New York.
	8		Unassigned recruits.
	20		Recruits left Fort Columbus for Battery L, Sept. 5, 1872.
	89		Recruits left Fort Columbus, October 11, 1872.
			20 recruits ordered to Light Battery K, October 5, 1872.
Total.....	686		Regiment ordered to Departments of the South and Gulf.

SECOND REGIMENT OF ARTILLERY.

Headquarters.....		Aug. 31, 1872	Presidio, San Francisco, California.
Non-commissioned, staff, & battalion.	22	do	Do.
Light Battery A.....	55	do	Do.
B.....	60	do	Alcatraz Island, California.
C.....	58	do	Sitka, Alaska.
D.....	55	do	Point San José, California.
E.....	40	do	Cape Disappointment, Wyoming Territory.
F.....	55	do	Presidio, San Francisco, California.
G.....	56	do	Do.
H.....	60	do	Sitka, Alaska.
I.....	32	do	Presidio, San Francisco, California.
K.....	48	do	Fort Monroe, Virginia.
L.....	34	do	Alcatraz Island, California.
M.....	42	do	Fort Stevens, Oregon.
	12		Unassigned recruits.
Total.....	629		Regiment ordered to Departments of the East and South.

Statement showing the organization of the Regular Army, &c.—Continued.

THIRD REGIMENT OF ARTILLERY.

Companies, &c.	Enlisted men present and absent.	Date of report.	Station.
Headquarters.....		Aug. 31, 1872	Charleston, South Carolina.
Non-commissioned, staff, & battalion.	29	do	Do.
A.....	56	do	Fort Monroe, Virginia.
B.....	43	do	Key West, Florida.
Light Battery C.....	62	do	Charleston, South Carolina.
D.....	41	do	Key West, Florida.
E.....	48	do	Fort Pulaski, Georgia.
F.....	49	do	Fort Jefferson, Florida.
G.....	47	do	Fort Barrancas, Florida.
H.....	51	do	Fort Pulaski, Georgia.
I.....	48	do	Charleston, South Carolina.
K.....	45	do	Savannah, Georgia.
L.....	47	do	Fort Barrancas, Florida.
M.....	39	do	Do.
Total.....	596		Regiment ordered to the Military Division of the Atlantic.

FOURTH REGIMENT OF ARTILLERY.

Headquarters.....		Aug. 31, 1872	Fort McHenry, Maryland.
Non-commissioned, staff, & battalion.	12	do	Do.
A.....	44	do	Charlotte, North Carolina.
Light Battery B.....	52	do	Fort McHenry, Maryland.
C.....	42	do	Raleigh, North Carolina.
D.....	43	do	Do.
E.....	59	do	Fort McHenry, Maryland.
F.....	47	do	Do.
G.....	32	do	Fort Johnston, North Carolina.
H.....	45	do	Raleigh, North Carolina.
I.....	54	do	Fort Monroe, Virginia.
K.....	43	do	Fort Macon, North Carolina.
L.....	43	do	Do.
M.....	41	do	Fort Foote, Maryland.
Total.....	572		Unassigned recruits. 29 recruits ordered to Light Battery B, October 2, 1872. Regiment ordered to the Military Division of the Pacific.

FIFTH REGIMENT OF ARTILLERY.

Headquarters.....		Aug. 31, 1872	Fort Adams, Rhode Island.
Non-commissioned, staff, & battalion.	21	do	Do.
A.....	41	do	Do.
B.....	40	do	Do.
C.....	56	do	Fort Monroe, Virginia.
D.....	39	do	Fort Warren, Massachusetts.
E.....	39	do	Fort Independence, Massachusetts.
Light Battery F.....	66	do	Fort Adams, Rhode Island.
G.....	37	do	Plattsburgh Barracks, New York.
H.....	43	do	Fort Trumbull, Connecticut.
I.....	41	do	Do.
K.....	34	do	Fort Sullivan, Maine.
L.....	36	do	Fort Adams, Rhode Island.
M.....	35	do	Fort Preble, Maine.
	1		Recruit left Fort Columbus, September 23, 1872.
	4		Recruits left Fort Columbus, October 5, 1872.
Total.....	526		

Statement showing the organization of the Regular Army, &c.—Continued.

FIRST REGIMENT OF INFANTRY.

Companies, &c.	Enlisted men present and absent.	Date of report.	Station.
Headquarters.....		Aug. 31, 1872	Fort Wayne, Michigan.
Non-commissioned, staff, & battalion.	23	do	Do.
A.....	33	do	Fort Brady, Michigan.
B.....	34	do	Madison Barracks, New York.
C.....	47	do	Fort Porter, New York.
D.....	34	do	Fort Wayne, Michigan.
E.....	42	do	Do.
F.....	26	do	Fort Mackinac, Michigan.
G.....	50	do	Fort Porter, New York.
H.....	44	do	Fort Gratiot, Michigan.
I.....	50	do	Fort Wayne, Michigan.
K.....	21	do	Fort Brady, Michigan.
	157		Recruits left Newport Barracks, September 12 and 25, 1872.
Total.....	567		

SECOND REGIMENT OF INFANTRY.

Headquarters.....		Aug. 31, 1872	Mobile, Alabama.
Non-commissioned, staff, & battalion.	24	do	Do.
A.....	48	do	Atlanta, Georgia.
B.....	39	do	Do.
C.....	47	do	Huntsville, Alabama.
D.....	40	do	Spartanburgh, South Carolina.
E.....	39	do	Chattanooga, Tennessee.
F.....	41	do	Saint Augustine, Florida.
G.....	47	do	Mobile, Alabama.
H.....	41	do	Saint Augustine, Florida.
I.....	31	do	Chattanooga, Tennessee.
K.....	50	do	Mobile, Alabama.
Total.....	447		

THIRD REGIMENT OF INFANTRY.

Headquarters.....		Aug. 31, 1872	Fort Hays, Kansas.
Non-commissioned, staff, & battalion.	25	do	Do.
A.....	56	do	Fort Dodge, Kansas.
B.....	59	do	Camp Supply, Indian Territory.
C.....	58	do	Fort Hays, Kansas.
D.....	56	do	Camp Supply, Indian Territory.
E.....	59	do	Fort Hays, Kansas.
F.....	41	do	Fort Lyon, Colorado Territory.
G.....	47	do	Do.
H.....	41	do	Fort Wallace, Kansas.
I.....	58	do	Camp Supply, Indian Territory.
K.....	51	do	Fort Leavenworth, Kansas.
	39		102 recruits left Newport Barracks, July 10, 1872; 63 joined.
Total.....	590		

Statement showing the organization of the Regular Army, &c.—Continued.

FOURTH REGIMENT OF INFANTRY.

Companies, &c.	Enlisted men present and absent.	Date of report.	Station.
Headquarters.....		Aug. 31, 1872	Frankfort, Kentucky.
Non-commissioned, staff, & battalion		.....do.....	Do.
A.....	19	.....do.....	Lexington, Kentucky.
B.....	54	.....do.....	Crab Orchard, Kentucky.
C.....	43	.....do.....	Lebanon, Kentucky.
D.....	49	.....do.....	Frankfort, Kentucky.
E.....	47	.....do.....	Mount Sterling, Kentucky.
F.....	54	.....do.....	Elizabethtown, Kentucky.
G.....	52	.....do.....	Paducah, Kentucky.
H.....	60	.....do.....	Louisville, Kentucky.
I.....	50	.....do.....	Lebanon Kentucky.
J.....	57	.....do.....	Frankfort, Kentucky.
K.....	43	.....do.....	Frankfort, Kentucky.
Total.....	528		

FIFTH REGIMENT OF INFANTRY.

Headquarters.....		Aug. 31, 1872	Fort Leavenworth, Kansas.
Non-commissioned, staff, & battalion.		.....do.....	Do.
A.....	20	.....do.....	Do.
B.....	58	.....do.....	Fort Scott, Kansas.
C.....	59	.....do.....	Fort Dodge, Kansas.
D.....	58	.....do.....	Fort Larned, Kansas.
E.....	59	.....do.....	Fort Hays, Kansas.
F.....	57	.....do.....	Fort Larned, Kansas.
G.....	58	.....do.....	Fort Leavenworth, Kansas.
H.....	58	.....do.....	Do.
I.....	58	.....do.....	Do.
J.....	58	.....do.....	Do.
K.....	58	.....do.....	Do.
Total.....	601		

SIXTH REGIMENT OF INFANTRY.

Headquarters.....		Aug. 31, 1872	Fort Buford, Dakota Territory.
Non-commissioned, staff, & battalion.		.....do.....	Do.
A.....	26	.....do.....	Do.
B.....	52	.....do.....	Northern Pacific Railroad and Missouri River.
C.....	48	.....do.....	Do.
D.....	45	.....do.....	Fort Buford, Dakota Territory.
E.....	56	.....do.....	Do.
F.....	57	.....do.....	Do.
G.....	57	.....do.....	Do.
H.....	59	.....do.....	Fort Stevenson, Dakota Territory.
I.....	57	.....do.....	Fort Buford, Dakota Territory.
J.....	59	.....do.....	Fort Stevenson, Dakota Territory.
K.....	57	.....do.....	100 recruits left Fort Columbus, June 25, 1872; 66 joined.
	34		Recruits left Newport Barracks, August 2, 1872.
	3		
Total.....	616		

Statement showing the organization of the Regular Army, &c.—Continued.

SEVENTH REGIMENT OF INFANTRY.

Companies, &c.	Enlisted men present and absent.	Date of report.	Station.
Headquarters		Aug. 31, 1872	Fort Shaw, Montana Territory.
Non-commissioned, staff, & battalion.	20	do	Do.
A	59	do	Fort Ellis, Montana Territory.
B	59	do	Fort Benton, Montana Territory.
C	42	do	Do.
D	48	do	Fort Shaw, Montana Territory.
E	50	do	Do.
F	46	do	Do.
G	37	do	Do.
H	58	do	Fort Baker, Montana Territory.
I	47	do	Fort Shaw, Montana Territory.
K	57	do	Do.
	19		100 recruits left Fort Columbus, July 3, 1872; 81 joined.
	14		Musicians left Fort Columbus, September 18, 1872.
Total	556		

EIGHTH REGIMENT OF INFANTRY.

Headquarters		Aug. 31, 1872	Fort D. A. Russell, Wyoming Territory.
Non-commissioned, staff, & battalion.	25	do	Do.
A	38	do	Fort Rice, Dakota Territory.
B	50	June 30, 1872	Do.
C	47	Aug. 31, 1872	Do.
D	46	do	Beaver City, Utah Territory.
E	47	do	Do.
F	50	June 30, 1872	Fort Rice, Dakota Territory.
G	42	Aug. 31, 1872	Beaver City, Utah Territory.
H	55	June 30, 1872	Fort Rice, Dakota Territory.
I	37	Aug. 31, 1872	Beaver City, Utah Territory.
K	53	June 30, 1872	Fort Rice, Dakota Territory.
	13		Unassigned recruits.
	3		Musicians left Fort Columbus, July 3, 1872.
	80		Recruits left Newport Barracks for Companies D, E, G, and I, August 22, 1872.
Total	586		

NINTH REGIMENT OF INFANTRY.

Headquarters		Aug. 31, 1872	Omaha Barracks, Nebraska.
Non-commissioned, staff, & battalion.	20	do	Do.
A	33	do	Do.
B	34	do	Red Willow Creek, Nebraska.
C	62	do	Omaha Barracks, Nebraska.
D	53	do	Fort D. A. Russell, Wyoming Territory.
E	56	do	Omaha Barracks, Nebraska.
F	55	do	Fort D. A. Russell, Wyoming Territory.
G	46	do	Sidney Barracks, Nebraska.
H	49	do	Fort Sanders, Wyoming Territory.
I	48	do	Fort D. A. Russell, Wyoming Territory.
K	54	do	Fort Fred Steele, Wyoming Territory.
	4		Recruits left Newport Barracks, August 22, 1872.
Total	554		

REPORT OF THE SECRETARY OF WAR

Statement showing the organization of the Regular Army, &c.—Continued.

TENTH REGIMENT OF INFANTRY.

Companies, &c.	Enlisted men present and absent.	Date of report.	Station.
Headquarters.....		Aug. 31, 1872	Fort McKavett, Texas.
Non-commissioned, staff, & battalion.	19	do	Do.
A.....	46	do	Do.
B.....	52	do	Do.
C.....	53	do	San Antonio, Texas.
D.....	50	do	Austin, Texas.
E.....	51	do	Fort McKavett, Texas.
F.....	49	do	Do.
G.....	40	do	Fort Clark, Texas.
H.....	47	do	Do.
I.....	53	do	Fort McKavett, Texas.
K.....	51	do	Fort Clark, Texas.
Total	511		

ELEVENTH REGIMENT OF INFANTRY.

Headquarters.....		Aug. 31, 1872	Fort Griffin, Texas.
Non-commissioned, staff, & battalion.	19	do	Do.
A.....	37	do	Do.
B.....	40	do	Fort Concho, Texas.
C.....	43	do	Fort Richardson, Texas.
D.....	46	do	Do.
E.....	36	do	Fort Concho, Texas.
F.....	47	do	Fort Griffin, Texas.
G.....	34	do	Do.
H.....	44	do	Fort Concho, Texas.
I.....	44	do	Fort Richardson, Texas.
K.....	53	do	Do.
	9		Recruits left Fort Columbus, July 6, 1872.
Total	452		

TWELFTH REGIMENT OF INFANTRY.

Headquarters.....		Aug. 31, 1872	Angel Island, California.
Non-commissioned, staff, & battalion.	24	do	Do.
A.....	40	do	Fort Yuma, California.
B.....	51	do	Camp Independence, California.
C.....	40	do	Fort Hall, Idaho Territory.
D.....	37	do	Fort Yuma, California.
E.....	50	do	Camp Wright, California.
F.....	52	do	Camp Beale's Springs, Arizona Territory.
G.....	45	do	Camp Gaston, California.
H.....	51	do	Camp Halleck, Nevada.
I.....	31	do	Department of Arizona.
K.....	37	do	Camp Gaston, California.
	5		Recruits left Fort Columbus, July 29, 1872.
Total	463		

Statement showing the organization of the Regular Army, &c.—Continued.

THIRTEENTH REGIMENT OF INFANTRY.

Companies, &c.	Enlisted men present and absent.	Date of report.	Station.
Headquarters.....		Aug. 31, 1872	Fort Fred Steele, Wyoming Territory.
Non-commissioned, staff, & battalion.	25	do	Do.
A.....	55	do	Camp Brown, Wyoming Territory.
B.....	26	do	Camp Douglas, Utah Territory.
C.....	39	do	Do.
D.....	38	do	Do.
E.....	40	do	Do.
F.....	37	do	Do.
G.....	41	do	Fort Bridger, Wyoming Territory.
H.....	49	do	Camp Douglas, Utah Territory.
I.....	52	do	Do.
K.....	47	do	Camp Stambaugh, Wyoming Territory.
	150		Recruits left Fort Columbus, August 31, 1872.
Total	599		

FOURTEENTH REGIMENT OF INFANTRY.

Headquarters.....		Aug. 31, 1872	Fort Laramie, Wyoming Territory.
Non-commissioned, staff, & battalion.	27	do	Do.
A.....	48	do	Do.
B.....	52	do	Do.
C.....	47	do	Fort D. A. Russell, Wyoming Territory.
D.....	50	do	Fort Fetterman, Wyoming Territory.
E.....	52	do	Do.
F.....	53	do	Do.
G.....	47	do	Do.
H.....	51	do	Fort Laramie, Wyoming Territory.
I.....	49	do	Do.
K.....	47	do	Do.
	1		Recruit left Fort Columbus, July 29, 1872.
	1		Recruit left Newport Barracks, August 22, 1872.
			85 recruits ordered, October 9, 1872.
Total	525		

FIFTEENTH REGIMENT OF INFANTRY.

Headquarters.....		Aug. 31, 1872	Santa Fé, New Mexico Territory.
Non-commissioned, staff, & battalion.	16	do	Do.
A.....	48	do	Fort Wingate, New Mexico Territory.
B.....	47	do	Fort McRae, New Mexico Territory.
C.....	54	do	Fort Union, New Mexico Territory.
D.....	47	do	Fort Garland, Colorado Territory.
E.....	49	do	Fort Bayard, New Mexico Territory.
F.....	49	do	Do.
G.....	49	do	Fort Cummings, New Mexico Territory.
H.....	50	do	Fort Craig, New Mexico Territory.
I.....	50	do	Fort Stanton, New Mexico Territory.
K.....	46	do	Fort Tulerosa, New Mexico Territory.
	93	do	100 recruits left Fort Columbus, August 5, 1872; 7 joined.
Total	598		

Statement showing the organization of the Regular Army, &c.—Continued.

SIXTEENTH REGIMENT OF INFANTRY.

Companies, &c.	Enlisted men present and absent.	Date of report.	Station.
Headquarters.....		Aug. 31, 1872	Nashville, Tennessee.
Non-commissioned, staff & battalion.....	19	do	Do.
A.....	58	do	Louisville, Kentucky.
B.....	41	do	Jackson, Mississippi.
C.....	56	do	Aberdeen, Mississippi.
D.....	47	do	Humboldt, Tennessee.
E.....	49	do	Louisville, Kentucky.
F.....	51	do	Nashville, Tennessee.
G.....	40	do	Do.
H.....	39	do	Jackson, Mississippi.
I.....	47	do	Do.
K.....	45	do	Saint Augustine, Florida.
	8		Unassigned recruits.
Total.....	500		

SEVENTEENTH REGIMENT OF INFANTRY.

Headquarters.....		Aug. 31, 1872	Fort Rice, Dakota Territory.
Non-commissioned, staff & battalion.....	20	do	Do.
A.....	50	June 30, 1872	Grand River Agency, Dakota Territory.
B.....	59	Aug. 31, 1872	Big Cheyenne Agency, Dakota Territory.
C.....	49	June 30, 1872	Do.
D.....	57	Aug. 31, 1872	Otter Crossing, Dakota Territory.
E.....	59	do	Fort Rice, Dakota Territory.
F.....	39	do	Grand River Agency, Dakota Territory.
G.....	59	do	Fort Rice, Dakota Territory.
H.....	57	do	Fort Totten, Dakota Territory.
I.....	58	do	Fort Rice, Dakota Territory.
K.....	57	do	Do.
	60		151 recruits sent from Newport Barracks, August 2, 1872; 91 joined.
Total.....	624		

EIGHTEENTH REGIMENT OF INFANTRY.

Headquarters.....		Aug. 31, 1872	Columbia, South Carolina.
Non-commissioned, staff & battalion.....	28	do	Do.
A.....	49	do	Atlanta, Georgia.
B.....	49	do	Columbia, South Carolina.
C.....	40	do	Yorkville, South Carolina.
D.....	45	do	Columbia, South Carolina.
E.....	45	do	Atlanta, Georgia.
F.....	42	do	Sumter, South Carolina.
G.....	42	do	Columbia, South Carolina.
H.....	43	do	Chester, South Carolina.
I.....	46	do	Laurensville, South Carolina.
K.....	31	do	Newberry, South Carolina.
Total.....	460		

Statement showing the organization of the Regular Army, &c.—Continued.

NINETEENTH REGIMENT OF INFANTRY.

Companies, &c.	Enlisted men present and absent.	Date of report.	Station.
Headquarters.....		Aug. 31, 1872	Baton Rouge, Louisiana.
Non-commissioned, staff, & battalion.	20	do	Do.
A.....	53	do	Do.
B.....	43	do	Do.
C.....	51	do	East Pascagoula, Mississippi.
D.....	44	do	Do.
E.....	39	do	Holly Springs, Mississippi.
F.....	44	do	Baton Rouge, Louisiana.
G.....	46	do	Do.
H.....	54	do	East Pascagoula, Mississippi.
I.....	39	do	Baton Rouge, Louisiana.
K.....	54	do	Little Rock, Arkansas.
Total.....	487		

TWENTIETH REGIMENT OF INFANTRY.

Headquarters.....		Aug. 31, 1872	Fort Snelling, Minnesota.
Non-commissioned, staff, & battalion.	23	do	Do.
A.....	50	do	Fort Abercrombie, Dakota Territory.
B.....	53	do	Fort Cross, Dakota Territory.
C.....	46	do	Fort Snelling, Minnesota.
D.....	45	do	Fort Cross, Dakota Territory.
E.....	48	do	Fort Totten, Dakota Territory.
F.....	50	do	Fort Wadsworth, Dakota Territory.
G.....	49	do	Fort Ripley, Minnesota.
H.....	50	do	Fort Totten, Dakota Territory.
I.....	47	do	Fort Pembina, Dakota Territory.
K.....	37	do	Do.
	2		Unassigned recruits.
	100		Recruits left Fort Columbus, September 12, 1-72.
Total.....	600		

TWENTY-FIRST REGIMENT OF INFANTRY.

Headquarters.....		Aug. 31, 1872	Fort Vancouver, Washington Territory.
Non-commissioned, staff, & battalion.	18	do	Do.
A.....	61	do	Camp Harney, Oregon.
B.....	51	do	Do.
C.....	48	do	Fort Vancouver, Washington Territory.
D.....	43	do	Camp Warner, Oregon.
E.....	52	do	Colville, Washington Territory.
F.....	50	do	Fort Klamath, Oregon.
G.....	43	do	Fort Lapwai, Idaho Territory.
H.....	43	do	San Juan Island, Washington Territory.
I.....	46	do	Fort Vancouver, Washington Territory.
K.....	46	do	Fort Boise, Idaho Territory.
	3		5 recruits left Fort Columbus, July 29, 1872: 2 joined.
Total.....	504		

REPORT OF THE SECRETARY OF WAR.

Statement showing the organization of the Regular Army, &c.—Continued.

TWENTY-SECOND REGIMENT OF INFANTRY.

Companies, &c.	Enlisted men present and absent.	Date of report.	Station.
Headquarters.....		Aug. 31, 1872	Fort Sully, Dakota Territory.
Non-commissioned, staff, & battalion.	22	do	Do.
A.....	56	do	Do.
B.....	52	do	Fort Randall, Dakota Territory.
C.....	52	do	Lower Brûle Agency, Dakota Territory.
D.....	44	June 30, 1872	Fort Randall, Dakota Territory.
E.....	54	Aug. 31, 1872	Fort Sully, Dakota Territory.
F.....	56	June 30, 1872	Do.
G.....	44	do	Fort Randall, Dakota Territory.
H.....	48	Aug. 31, 1872	Do.
I.....	56	do	Fort Sully, Dakota Territory.
J.....	39	do	Fort Randall, Dakota Territory.
K.....	100		Recruits left Fort Columbus, September 18, 1872.
Total	623		

TWENTY-THIRD REGIMENT OF INFANTRY.

Headquarters.....		Aug. 31, 1872	Fort Whipple, Arizona Territory.
Non-commissioned, staff, & battalion.	13	do	Do.
A.....	41	do	Benicia Barracks, California.
B.....	34	do	Camp Date Creek, Arizona Territory.
C.....	49	do	Camp McDowell, Arizona Territory.
D.....	53	do	Camp Crittenden, Arizona Territory.
E.....	60	do	Camp Lowell, Arizona Territory.
F.....	60	June 30, 1872	Camp Bowie, Arizona Territory.
G.....	39	Aug. 31, 1872	Camp Hualpai, Arizona Territory.
H.....	51	do	Camp Grant, Arizona Territory.
I.....	45	June 30, 1872	Camp Verde, Arizona Territory.
J.....	40	Aug. 31, 1872	Camp Whipple, Arizona Territory.
K.....	1		Recruit left Fort Columbus, July 22, 1872.
Total	486		

TWENTY-FOURTH REGIMENT OF INFANTRY.

Headquarters.....		Aug. 31, 1872	Fort Brown, Texas.
Non-commissioned, staff, & battalion.	20	do	Do.
A.....	56	do	Ringgold Barracks, Texas.
B.....	58	do	Do.
C.....	56	do	Fort Brown, Texas.
D.....	54	do	Fort McIntosh, Texas.
E.....	59	June 30, 1872	Fort Brown, Texas.
F.....	58	Aug. 31, 1872	Fort Duncan, Texas.
G.....	57	do	Fort Brown, Texas.
H.....	56	do	Do.
I.....	56	do	Do.
J.....	59	do	Fort Duncan, Texas.
K.....	4		55 recruits left Newport Barracks, January 7, 1872; 51 joined.
	28		Recruits left Fort Columbus, July 6, 1872.
Total	621		

Statement showing the organization of the Regular Army, &c.—Continued.

TWENTY-FIFTH REGIMENT OF INFANTRY.

Companies, &c.	Enlisted men present and absent.	Date of report.	Station.
Headquarters		Aug. 31, 1872	Fort Davis, Texas.
Non-commissioned, staff, & battalion.	20	do	Do.
A.....	58	do	San Antonio, Texas.
B.....	58	do	Fort Bliss, Texas.
C.....	58	do	Fort Gibson, Indian Territory.
D.....	56	do	Fort Davis, Texas.
E.....	59	do	Do.
F.....	57	do	Fort Stockton, Texas.
G.....	58	do	Fort Davis, Texas.
H.....	56	do	Fort Bliss, Texas.
I.....	59	do	Fort Gibson, Indian Territory.
K.....	59	do	Fort Stockton, Texas.
	41		48 recruits left Newport Barracks, April 25, 1872; 7 joined.
Total	640		

ENGINEER BATTALION.

Headquarters		Aug. 31, 1872	Willet's Point, New York Harbor.
Non-commissioned, staff, & battalion.	15	do	Do.
A.....	71	do	Do.
B.....	71	do	Do.
C.....	69	do	Do.
D.....	17	do	Do.
E.....	75	do	West Point, New York.
Total	318		

	Enlisted men.	Date of report.
Available recruits at Fort Columbus, New York Harbor—general service and colored.	208	Oct. 20, 1872
Available recruits at Newport Barracks, Kentucky—general service and colored.	95	do
Available recruits at Saint Louis depot, Missouri—mounted service	350	Oct. 10, 1872
Total	653	
Permanent and recruiting parties, music-boys, and recruits at depots, not available for assignment.	1,009	Oct. 10, 187
General-service men on duty in bureaus of the War Department, Army, Division, and Department headquarters, &c.	442	Aug. 31, 1879
Ordnance Department	448	do
West-Point detachments	238	do
Signal detachment	229	do
Hospital-stewards	381	do
Ordnance-sergeants	116	do

NOTE.—The standard strength—enlisted men—of the following-named organizations is as follows:

Engineer Battalion	35
Infantry Regiment	605
Infantry Company	60
Artillery Regiment	749
Battery of Artillery	60
Light Battery of Artillery	84
Cavalry Regiment	1,013
Cavalry Company	84

RECAPITULATION.

Regiment.	Number of men.	Regiment.	Number of men.
First Cavalry	925	Seventeenth Infantry	624
Second Cavalry	*813	Eighteenth Infantry	460
Third Cavalry	†925	Nineteenth Infantry	457
Fourth Cavalry	933	Twentieth Infantry	600
Fifth Cavalry	1,010	Twenty-first Infantry	504
Sixth Cavalry	1,009	Twenty-second Infantry	623
Seventh Cavalry	764	Twenty-third Infantry	426
Eighth Cavalry	963	Twenty-fourth Infantry	621
Ninth Cavalry	632	Twenty-fifth Infantry	640
Tenth Cavalry	691	Engineer Battalion	318
First Artillery	*646	Permanent and recruiting parties, music-boys, and recruits not available for assignment.	1,009
Second Artillery	629		
Third Artillery	596		
Fourth Artillery	‡572	General-service men on duty in the bureau of the War Department, Army, Division, and Department headquarters, &c.	442
Fifth Artillery	528		
First Infantry	567		
Second Infantry	447		
Third Infantry	530	Ordnance Department	448
Fourth Infantry	522	West-Point detachments	238
Fifth Infantry	601	Signal detachment	229
Sixth Infantry	616	Hospital-stowards	381
Seventh Infantry	556	Ordnance-surgeons	116
Eighth Infantry	586	Available recruits at depots	653
Ninth Infantry	554	Recruits sent to batteries of artillery at Fort Monroe, September 7, 1872.	30
Tenth Infantry	511		
Eleventh Infantry	452		
Twelfth Infantry	463	Total enlisted men	29,336
Thirteenth Infantry	599	Commissioned officers	2,104
Fourteenth Infantry	‡325		
Fifteenth Infantry	598	Aggregate	31,440
Sixteenth Infantry	500		

* 150 recruits ordered, October 16, 1872.

† 85 recruits ordered, October 16, 1872.

‡ 20 recruits ordered to Light Battery K, October 5, 1872.

§ 29 recruits ordered to Light Battery B, October 8, 1872.

|| 85 recruits ordered, October 9, 1872.

WM. D. WHIPPLE.
Assistant Adjutant-General.

REPORT OF LIEUTENANT-GENERAL SHERIDAN.

HEADQUARTERS MILITARY DIVISION OF THE MISSOURI,
Chicago, Illinois, October 12, 1872.

GENERAL: I have the honor to submit, for the information of the General of the Army, my annual report, accompanied by the reports of the Department commanders.

The Military Division of the Missouri is composed of the Departments of Dakota, the Platte, the Missouri, and Texas, commanded respectively by Major-General Winfield S. Hancock, Brigadier-General Edward O. C. Ord, Brigadier-General John Pope, and Brigadier-General Christopher O. Augur. It embraces a large extent of territory, having a great diversity of interests, and contains nearly all the restless and hostile bands of Indians. For the protection of these interests, and to hold the restless and hostile Indians in check, seventy-two military posts and a number of summer encampments are occupied at necessary points from the line of British Columbia to the Gulf of Mexico, and from the Missouri River to the eastern line of California and Arizona. These posts are garrisoned by seven regiments of cavalry, with an aggregate strength for duty of 4,474 men, and fifteen regiments of infantry, with an aggregate strength for duty of 6,771 men. The demands made upon this small force for the protection of settlements and railroads; escorts for authorized exploring expeditions; the protection of the long line of the Grande, and of Indian agents on reservations, &c., &c., have given

it active work during the past year, for a detailed account of which I respectfully refer you to the accompanying reports of the department commanders.

The line of frontier settlements has steadily advanced during the year, especially in Kansas, Nebraska, Minnesota, and Dakota, gradually absorbing the country which only a year or two since was in the possession of the Indians.

The Northern Pacific Railroad will, on the 1st day of January next, have reached the Missouri River, and actual surveys and location are now being made as far west as the mouth of Powder River, a distance of nearly two hundred miles west of the Missouri River. This surveying party is protected by a strong force from General Hancock's department, under command of Colonel D. S. Stanley. A preliminary surveying party, escorted by Major E. M. Baker, started down the Yellowstone Valley from Fort Ellis, to connect with this surveying party at the mouth of Powder River, but was unsuccessful in accomplishing its design on account of the demonstrations of hostile Indians. It, however, returned, making a preliminary survey up the valley of the Musselshell, so that the expedition need not be considered an entire failure.

These surveying parties have required large escorts, and should the railroad go on next year, an additional force, and especially of mounted troops, will be required for its protection, as well as the establishment of one or two large permanent posts. Two new posts have been established on the line of this road, one at the crossing of James River, in Dakota, the other at the crossing of the Missouri River, near the mouth of Hart River.

No additional protection has been required this year for the Union Pacific Railroad, and the same is also true of the Kansas Pacific Railway.

The Atchison, Topeka and Santa Fé Railroad has been pushed forward with commendable energy, passing by Fort Larned and up the Arkansas River, to Fort Dodge, to which place I believe it is now in successful operation.

The Atlantic and Pacific road, which is to run up the valley of the main Canadian River, has not yet passed beyond the frontier line of settlements, but preliminary surveys farther west have already been made.

Orders were given for the concentration of escorts for the surveying parties of the Southern Pacific road at El Paso; one party to work east from that point, and the other to work west toward Arizona.

The demands for the protection of all these great enterprises, and the development they will give our agricultural and new mineral interests, indicate work for some time to come for that portion of the Army located along the line of this frontier.

There have been no general hostilities by the Indians this year, but the number of murders and depredations committed by small war parties is greater than during the year preceding.

I fully indorse the efforts now being made to civilize and Christianize the wild Indians, and think that the reservation system and the policy of the Government toward the wild tribes is the most liberal and humane that has ever been adopted by any governments toward savage people; and so far as the military is concerned, every effort will be made to carry out its intentions. The principal error that I discover in its successful management is that, while efforts are being made to teach the Indian what is right, and to induce him to do right, sufficient importance has not been given to teaching him what is wrong.

I very much fear that the course pursued toward the wild Indian does not cause him to fully realize from his own standpoint that he is doing wrong when he commits murders and other depredations, and if some wise system of punishment could be arranged and carried out which would have the effect of controlling him in this respect, it would much sooner terminate the Indian troubles on our frontier.

Looking at the present progress of settlement and the speed at which the great lines of railways are being constructed, the time cannot be far distant when we will be required to make every portion of our territory safe for our citizens to travel over.

The troops generally are comfortably quartered, and there has been less desertion since the passage of the pay-bill approved May 15, 1872.

Much embarrassment and probably waste of money has occurred by the provisions of the clause in the appropriation bill approved May 18, 1872, which requires that no permanent posts "whose cost shall exceed \$20,000," can be established without the concurrence of Congress. This necessitates a waste of money for temporary shelters, which could otherwise be used in the construction of permanent posts. It has been necessary to establish such posts on the Tularosa reservation in New Mexico, and at Beaver City, Utah Territory, and the construction of these posts as well as those on the line of the Northern Pacific Railroad, has been greatly embarrassed by the clause in the act referred to.

I also desire to call the attention of the honorable Secretary of War to the embarrassment that arises from the law of Congress which prevents the transfer of the funds of one appropriation to those of another. It complicates matters and at times obliges us to go before Congress with deficiency bills, while there are unexpended balances in the hands of the War Department that otherwise could be applied to cover unforeseen expenditures in other quarters; besides operating so as to create extra and separate sets of papers for the disbursement of these special funds.

The provisions now being made by Brigadier-General C. C. Augur for the better protection of the line of the Rio Grande from the thieving bands from Mexico, will, it is believed, greatly modify this evil; but the great length of this line and the small force available for its protection, lead me to believe that the depredations can only be stopped by some international agreement.

I respectfully call the attention of the General of the Army to the great necessity existing of giving to the Army a new system of regulations.

The events of the late war in our country required so many new orders, and so complicated the old regulations, as to make them almost unintelligible.

The numerous irregularities of the service cannot well be corrected for want of some standard to go by. I therefore respectfully ask, in the name of the officers and soldiers of my military division, for a new system of regulations.

The strictest personal attention has been given to my command during the last year, and I take pleasure in announcing the cheerfulness with which every department commander has labored for economy and the good of the public service.

Very respectfully, your obedient servant,

P. H. SHERIDAN,

Lieutenant-General Commanding.

• Brigadier-General E. D. TOWNSEND,

Adjutant-General of the Army, Washington, D. C.

REPORT OF MAJOR-GENERAL HANCOCK.

HEADQUARTERS DEPARTMENT OF DAKOTA,
Saint Paul, Minnesota, October 3, 1872.

SIR: I have the honor to submit my annual report of military operations in this department since October 23, 1871.

The department is, as at that date, subdivided into districts as follows: District of Minnesota, district of Montana, and Middle District, and the independent post of Fort Buford, commanded respectively by Colonels George Sykes, Twentieth Infantry, John Gibbon, Seventh Infantry, D. S. Stanley, Twenty-second Infantry, and W. B. Hazen, Sixth Infantry.

The posts in the district of Minnesota are garrisoned by companies of the Twentieth Infantry, distributed as follows:

Fort Snelling, regimental headquarters and one company.

Fort Ripley, one company.

Fort Abercrombie, one company.

Fort Wadsworth, one company. (Another company of this garrison is now on temporary duty at Fort Cross; will be returned to Fort Wadsworth by November 1.)

Fort Totten, two companies. (To be increased during the winter by a company of the Seventeenth Infantry, which will proceed there on the return of the Yellowstone expedition.)

Fort Pembina, two companies.

Fort Cross, one company, (and until winter by an additional company detached from Fort Wadsworth.)

In the district of Montana the troops, consisting of four companies, Second Cavalry and the Seventh Infantry, are stationed as follows:

Fort Shaw, regimental headquarters and seven companies of infantry.

Fort Ellis, four companies of cavalry and one company of infantry.

Fort Benton, one company of infantry.

Camp Baker, one company of infantry.

The Seventeenth and Twenty-second and four companies of the Sixth Regiments of Infantry garrison the posts in the Middle District, and are distributed as follows:

Fort Sully, regimental headquarters and four companies of Twenty-second Infantry.

Fort Rice, regimental headquarters and five companies of Seventeenth Infantry.

Edwinton, one company of Seventeenth Infantry.

Fort Randall, five companies of Twenty-second Infantry.

Fort Stevenson, two companies of Sixth Infantry.

Fort McKeen, two companies of Sixth Infantry.

Lower Brulé agency, one company of Twenty-second Infantry.

Cheyenne agency, two companies of Seventeenth Infantry.

Grand River agency, two companies of the Seventeenth Infantry.

Six companies of the Eighth Infantry, under command of Lieutenant-Colonel H. D. Wallen. Eighth Infantry are temporarily on duty in the department, with the expedition, commanded by Colonel D. S. Stanley, Twenty-second Infantry, escorting the Northern Pacific Railroad surveying party to the Yellowstone River, Montana Territory. They are to be relieved from duty in this department on return of the expedition, about October 31, and sent to the Department of the Platte.

The independent post of Fort Buford is garrisoned by six companies of the Sixth Infantry, headquarters of the regiment being at the same post.

The approximate strength of these different commands, as shown by the last received official returns, is as follows:

<i>District of Minnesota.</i>			
Posts.		Officers.	Men.
Fort Snelling.....		6	72
Fort Ripley.....		3	50
Fort Abercrombie.....		5	52
Fort Wadsworth.....		6	51
Fort Totten.....		7	97
Fort Pembina.....		7	85
Fort Cross.....		5	98
Total.....		39	505

<i>District of Montana.</i>			
Posts.		Officers.	Men.
Fort Shaw.....		25	369
Fort Ellis.....		17	254
Fort Benton.....		3	60
Camp Baker.....		3	59
Total.....		48	742

<i>Middle District.</i>			
Posts.		Officers.	Men.
Fort Sully.....		17	251
Fort Rice.....		20	234
In camp near Edwinton, Dakota Territory.....		3	51
Fort Randall.....		17	228
Fort Stevenson.....		6	116
Fort McKeen.....		7	104
Lower Brulé agency.....		3	53
Cheyenne agency.....		5	86
Grand River agency.....		5	119
Total.....		83	1,242

<i>Troops temporarily on duty in the department.</i>			
		Officers.	Men.
Companies A, B, C, F, H, and K, Eighth Infantry.....		20	319

<i>Independent post.</i>			
Post.		Officers.	Men.
Fort Buford.....		21	407

In addition to the above statement of the strength of the command, there are now *en route*, but not as yet officially returned, as assigned to companies, recruits as follows: 40 for four companies, Second Cavalry, at Fort Ellis, Montana Territory; 114 for Seventh Infantry; 150 for Seventeenth Infantry; 100 for Twentieth Infantry, and 100 for Twenty second Infantry.

The grand total of troops heretofore mentioned as serving in, or *en route* to the Department of Dakota, is as follows:

Posts.	Officers.	Men.
District of Minnesota.....	39	505
District of Montana.....	48	742
Middle District.....	83	1,242
Fort Buford.....	21	407
Temporarily attached.....	20	319
Recruits <i>en route</i>		504
Grand total.....	211	3,719

The following changes in stations and movements of troops have been made in this department since last report, viz:

Headquarters and six companies of the Sixth Infantry to Fort Buford, Dakota Territory, relieving three companies Seventh Infantry; the latter proceeding to Fort Shaw, Montana Territory, and forming a part of that garrison.

Two companies Sixth Infantry to Fort Stevenson, Dakota Territory, relieving two companies Seventeenth Infantry, the latter proceeding to Fort Rice, Dakota Territory.

Two companies Sixth Infantry to a new post, "Fort McKeen," at the Northern Pacific Railroad crossing of the Missouri.

In Dakota, east of the Missouri, one company has been detailed from Fort Rice, and stationed for the winter at Edwinton, Dakota Territory, near the Northern Pacific Railroad crossing of the Missouri River, for the protection of the stores of the company and the employés at their depot at that point. One company of the Twentieth Infantry has been stationed at the Northern Pacific Railroad crossing of the James River, and a new post established there, designated Fort Cross. One company of the Seventeenth Infantry has been ordered from Fort Rice to Fort Totten, for quarters during the winter. With this exception the strength of the posts in companies will remain the same during this winter in Minnesota and Dakota as at the date of last report.

Several of the companies of the Twentieth Infantry have been in camp during the summer, protecting workmen of the Northern Pacific Railroad east of the Missouri River.

In Montana the strength of the posts remains as at date of last report, save that the garrison of Fort Shaw, Montana Territory, has been increased by three companies, as before stated, from Fort Buford.

During the past summer a detachment has been stationed at Flat-Head Pass, Montana Territory, as an additional protection to the Galatin Valley. It will be recalled as winter approaches.

From Fort Randall detachments have been stationed at Ponca Indian agency, for the protection of that tribe against hostile Indians, and a detachment has been stationed on the Niobrara, as a defense of the settlers against marauding Indians.

From Fort Ripply, Minnesota, frequent detachments have been made at the request of the agent of the Chippewas, to attend the payments of annuities, to preserve order, and as a protection for the employés of the Indian department and other persons at times of alarm.

A company of the Twentieth Infantry is detached from Fort Pembina to escort the boundary commission, and is still on that service.

The Indians of the plains, through some of their chiefs, notified us early in the spring that they intended to resist the building of the Northern Pacific Railroad west of the Missouri River, and, notwithstanding that threats of Indians are not always followed by acts, in this case it was proved they were not entirely idle, as attacks, more or less formidable, were subsequently made by them upon the commands sent as escorts to the railroad surveying parties operating during summer and fall on the Missouri and along the Yellowstone Rivers.

On the 29th June I received instructions from the Lieutenant General to prepare two commands as escorts for two principal surveying parties of the Northern Pacific Railroad Company, one to proceed from Fort Rice, on the Missouri River, to the mouth of Powder River, a distance of about two hundred and forty miles, and return; the other from Fort Ellis, Montana, to the mouth of Powder River, a distance of about three hundred and ten miles, and return by the Muscleshell.

The first-named body of troops was placed under the command of Colonel D. S. Stanley, Twenty-second Infantry, commanding the middle district of this department, and consisted of about 600 infantry and a battery of two Gatling guns and one brass 12-pounder.

The second detachment, under command of Major E. M. Baker, Second Cavalry, consisting of about 400 men, of which 182 were cavalry, the remainder infantry. These expeditions were deemed strong enough, in all probability, for the purposes for which they were intended. They would have been made stronger, however, had more troops been available.

Colonel Stanley's command started on the 1st of August from Fort Rice, and reached Powder River on the 18th, and is now on its return, escorting the engineers while making a detailed survey to the point of departure. The Indians skirmished with this command on several occasions, but up to the latest dates no serious encounter had occurred with them. It is quite probable, however, that the command will be attacked in force before its return, which is expected about the 31st instant. It is believed that this force will be successful in accomplishing the object for which it was organized. Our latest information from it was dated the 25th of August.

Major Baker's command started from Fort Ellis on the 27th of July. On the 14th of August, at Pryor's Fork, one hundred and forty-eight miles from Fort Ellis, it was attacked by a large body of Indians, who, after a contest of considerable duration, were repulsed. The command resumed its march subsequently, but after proceeding to a point styled "Pompey's Pillar," about twenty-four miles beyond Pryor's Fork, discontinued the march down the Yellowstone, owing, as I am informed, to the belief on the part of the railroad engineers that the force was not strong enough to give adequate protection to the party. It then proceeded to the Muscleshell, to perform the duty assigned it on that route, and was last heard from sixty miles below the forks of that stream.

It must be admitted that, in not proceeding to the mouth of Powder River, part of the objects of this expedition will not be accomplished this year. Whether the force was inadequate, the action of the commander judicious, or whether the responsibility for not proceeding farther rests with the railroad engineers, cannot be determined until we have further advices. The commander of the District of Montana has been directed to make an investigation into the conduct of the command, and when his report shall have been received it will be transmitted.

It is now quite evident (no matter what may transpire this fall affecting the movements of these expeditions) that to succeed in the construction of the railroad between the Missouri and Yellowstone Rivers, and along the latter to the Gallatin Valley, Montana, it will require much larger bodies of troops than we now have disposable in this department. An accession of cavalry is especially required.

In this connection it may be stated also that it will be necessary to establish military posts along that route, which, for a time at least, will have to be occupied by large garrisons—not less than a regiment at each post.

I recommend that a military post be established during the ensuing year at or near the point where the railroad from the east will strike the Yellowstone, (probably near the mouth of Powder River,) and when the railroad shall have been constructed beyond that point, (probably the ensuing year,) another post at or near the mouth of the Big Horn is suggested.

I do not suppose that the railroad will be built beyond the first-named point next year, and I therefore do not recommend the establishment of the latter post during the ensuing season. The expense of establishing such post will thus be much decreased, as by this delay we will be enabled to use the railroad as a means of transportation for supplies instead of the long and more expensive wagon-routes.

That the Indians intend to resist the building of the railroad I have no doubt, and it may be necessary before its completion to place the relations of the nomadic tribes in that region on a different basis from the present.

It will certainly be essential to compel the Indians concerned to recognize the authority of the Government in the territory in question before the railroad could be constructed and successfully operated. Passing, as the line does, through the great hunting-grounds of the Sioux tribes, it is practicable, considering their numbers, for them to collect such bodies of warriors, at comparatively short notice, as would effectually prevent the operation of the road.

Our Indian relations should, and no doubt will, be more clearly defined before the road is completed. The settlement of these relations will doubtless entail much expense, and the more, as the policies of the Government regarding Indians are not apparently direct, practical, and to the purpose.

At present, while bodies of our troops are moving from the Missouri to the Yellowstone, or from Montana down the latter river, escorting railroad surveyors, it is notorious, and not attempted to be concealed by the Indians themselves, that their supplies and munitions of war to enable them to carry on campaigns against these troops are provided directly by the authority of the Government at the different Indian agencies and at other points (trading-posts) within reach, at which establishments the employes have to be protected by troops from insults and violence of the same Indians. Even now supplies are being distributed to these Indians, who do not attempt, even while receiving their subsistence, to conceal the fact that when they leave these depots of supply it will be for the purpose of joining in attacks upon our troops who are engaged elsewhere in the surveys mentioned, and who otherwise occupy a friendly attitude toward the Indians; and it is known that when the Indians return from such attacks for further supplies they do not hesitate to boast of their achievements against our troops on their last foray, or of their purpose of hostility in the next.

In my opinion the time has arrived when it is but merciful and just to the Indians as well as to the whites to interfere with the nomadic habits of the former, at least when accompanied by such conditions as above described, even should it be necessary violently to place them on reservations and rigidly to keep them there.

It will, of course, in such event be necessary for the Government to provide for their subsistence to the extent that might be deemed necessary. But no matter what may be the course pursued by the authorities in the future, it is manifestly just that our charity to the Indian should not be the means of encouraging war against the troops of the Government, and, to that end, I would recommend that when subsistence supplies are provided to the Indians, they be issued to families or to separate individuals, and for short periods, daily if necessary, in order to prevent magazines of provisions being collected for hostile expeditions against the same authority which furnishes the supplies. This course might interfere with their periodical hunts now sanctioned by the Indian Department, but it would prevent those Indians who receive

REPORT OF THE SECRETARY OF WAR.

Statement showing the organization of the Regular Army, &c.—Continued.

TWENTY-SECOND REGIMENT OF INFANTRY.

Companies, &c.	Enlisted men present and absent.	Date of report.	Station.
Headquarters.....		Aug. 31, 1872	Fort Sully, Dakota Territory.
Non-commissioned, staff, & battalion.	22	do	Do.
A.....	56	do	Do.
B.....	52	do	Fort Randall, Dakota Territory.
C.....	52	do	Lower Brtlo Agency, Dakota Territory.
D.....	44	June 30, 1872	Fort Randall, Dakota Territory.
E.....	54	Aug. 31, 1872	Fort Sully, Dakota Territory.
F.....	56	June 30, 1872	Do.
G.....	44	do	Fort Randall, Dakota Territory.
H.....	48	Aug. 31, 1872	Do.
I.....	56	do	Fort Sully, Dakota Territory.
J.....	39	do	Fort Randall, Dakota Territory.
K.....	100		Recruits left Fort Columbus, September 18, 1872.
Total.....	623		

TWENTY-THIRD REGIMENT OF INFANTRY.

Headquarters.....		Aug. 31, 1872	Fort Whipple, Arizona Territory.
Non-commissioned, staff, & battalion.	13	do	Do.
A.....	41	do	Benicia Barracks, California.
B.....	34	do	Camp Date Creek, Arizona Territory.
C.....	49	do	Camp McDowell, Arizona Territory.
D.....	53	do	Camp Crittenden, Arizona Territory.
E.....	60	do	Camp Lowell, Arizona Territory.
F.....	60	June 30, 1872	Camp Bowie, Arizona Territory.
G.....	39	Aug. 31, 1872	Camp Hualpai, Arizona Territory.
H.....	51	do	Camp Grant, Arizona Territory.
I.....	45	June 30, 1872	Camp Verde, Arizona Territory.
J.....	40	Aug. 31, 1872	Camp Whipple, Arizona Territory.
K.....	1		Recruit left Fort Columbus, July 29, 1872.
Total.....	486		

TWENTY-FOURTH REGIMENT OF INFANTRY.

Headquarters.....		Aug. 31, 1872	Fort Brown, Texas.
Non-commissioned, staff, & battalion.	20	do	Do.
A.....	56	do	Ringgold Barracks, Texas.
B.....	58	do	Do.
C.....	56	do	Fort Brown, Texas.
D.....	54	do	Fort McIntosh, Texas.
E.....	59	June 30, 1872	Fort Brown, Texas.
F.....	58	Aug. 31, 1872	Fort Duncan, Texas.
G.....	57	do	Fort Brown, Texas.
H.....	56	do	Do.
I.....	56	do	Do.
J.....	59	do	Fort Duncan, Texas.
K.....	4		55 recruits left Newport Barracks, January 7, 1872; 51 joined.
	28		Recruits left Fort Columbus, July 6, 1872.
Total.....	621		

Statement showing the organization of the Regular Army, &c.—Continued.

TWENTY-FIFTH REGIMENT OF INFANTRY.

Companies, &c.	Enlisted men present and absent.	Date of report.	Station.
Headquarters.....		Aug. 31, 1872	Fort Davis, Texas.
Non-commissioned, staff, & battalion.	20	do	Do.
A.....	58	do	San Antonio, Texas.
B.....	50	do	Fort Bliss, Texas.
C.....	58	do	Fort Gibson, Indian Territory.
D.....	56	do	Fort Davis, Texas.
E.....	59	do	Do.
F.....	57	do	Fort Stockton, Texas.
G.....	58	do	Fort Davis, Texas.
H.....	56	do	Fort Bliss, Texas.
I.....	59	do	Fort Gibson, Indian Territory.
K.....	59	do	Fort Stockton, Texas.
	41		48 recruits left Newport Barracks, April 25, 1872; 7 joined.
Total.....	640		

ENGINEER BATTALION.

Headquarters.....		Aug. 31, 1872	Willet's Point, New York Harbor.
Non-commissioned, staff, & battalion.	15	do	Do.
A.....	71	do	Do.
B.....	71	do	Do.
C.....	69	do	Do.
D.....	17	do	Do.
E.....	75	do	West Point, New York.
Total.....	318		

	Enlisted men.	Date of report.
Available recruits at Fort Columbus, New York Harbor—general service and colored.	208	Oct. 20, 1872
Available recruits at Newport Barracks, Kentucky—general service and colored.	95	do
Available recruits at Saint Louis depot, Missouri—mounted service	350	Oct. 10, 1872
Total.....	653	
Permanent and recruiting parties, music-boys, and recruits at depots, not available for assignment.	1,009	Oct. 10, 187
General-service men on duty in bureaus of the War Department, Army, Division, and Department headquarters, &c.	442	Aug. 31, 1872
Ordnance Department.....	448	do
West Point detachments.....	238	do
Signal detachment.....	229	do
Hospital stewards.....	381	do
Ordnance-sergeants.....	116	do

NOTE.—The standard strength—enlisted men—of the following-named organizations is as follows:

Engineer Battalion.....	35
Infantry Regiment.....	605
Infantry Company.....	60
Artillery Regiment.....	749
Battery of Artillery.....	60
Light Battery of Artillery.....	84
Cavalry Regiment.....	1,013
Cavalry Company.....	84

annuities, and remain quiet tilling the soil, from being considered as merely old men and children incapable of hostility by other Indians, who, while drawing their supplies, none the less consider themselves at war with civilization and free to initiate hostilities against the Government.

There are several Indian agencies on the Missouri River in this department for the protection of which there are military stations, viz, Brulé, Cheyenne, and Grand River, besides trading-posts, as Fort Peck, Fort Belknap, and Fort Browning, also under the sanction of the Indian Department, but at which no troops are stationed, and established as depots of supply or convenience for purchases for Indians. To these points the wild Indians resort for the purpose of drawing their periodical supplies of subsistence, arms, and ammunition, and around them the old, the women, and children, and others who may feel disposed to plant, congregate, and pursue their inclinations so far as facilities may be offered. It was at first considered that no troops should be stationed at these agencies, in order, as far as possible, to separate them from the demoralizing influences supposed to be incident to their contact with whites. I then recommended that issues to Indians should be made at or near the great military posts, under the supervision of their commanders. That view was not favorably considered, however, as being inconsistent with the policy desired to be pursued by those having control of Indian relations. It was not long, however, before the violent action of the Indians made it necessary, in the opinion of the authorities controlling Indian affairs, to establish troops at the agencies to protect the employes from insult and outrage, and to guard the public property there, and thus military stations finally grew up at these points.

They are too weak, however, to command that respect which policy should dictate in dealing with Indians, and only serve their purpose, (in an inferior degree,) which would result from causing the issues to Indians to be placed under the supervision of the greater military posts. Under these circumstances there would seem to be no sufficient reasons why the military stations at these agencies should not be abandoned in the ensuing season, and the points of issue to Indians (especially considering their present attitude) be removed to the vicinity of the important military posts. Much money would thus be saved, and the authority of the Government would thereby be more respected by the Indians, and at the same time such control could be exercised over the issues to the latter as would be dictated by their good or bad conduct.

Trading-posts, when not under direct supervision of the Government authorities, and carried on under well-known prescribed regulations, should be broken up.

If arms are issued or sold to the Indians, they should not be our arms of precision, but only those of an inferior quality, yet suitable for the hunt, and in this matter we could wisely follow the practice of our neighbors in the British possessions.

The want of an additional cavalry force in this department has been heretofore mentioned by me, and in view of the new conditions forced upon us by the action of the Indians, this fact continues to be so apparent that I need add nothing further on the subject, as my superiors in authority are well informed in the matter.

I would also recommend that at least a regiment of infantry be ordered to this department in the ensuing spring for each of the new posts which it is proposed to establish on the Yellowstone, and this although we should continue to occupy our present defensive attitude toward the Indians.

It may be here stated that at this date the Northern Pacific Railroad is finished about thirty miles west of Fort Cross, on the James River, and one hundred and twenty-five miles west of the Red River of the North; there remains seventy miles to complete the road to the Missouri, and there is no reason to doubt its completion to that point (opposite Fort McKeen) before the winter has closed in. We now have communication with the last-named post by a telegraph-line constructed along the line of the railroad.

The Saint Paul and Pacific branch of the Northern Pacific Railroad, which connects with the main line of the latter at Brainerd, (passing Fort Ripley,) will be completed this fall, and also the branch of the same road running from Saint Paul via Saint Cloud and Sauk Centre to Pembina, Dakota Territory.

Another important railroad line for military purposes in this department has just been completed, (between Saint Paul and Sioux City, Iowa, on the Missouri River,) thus giving us quite a direct connection with the Union Pacific Railroad to Omaha, Nebraska.

The Winona and Saint Peter Railroad Company have also extended their line westward during the present year from New Ulm, Minnesota, seventy-six miles, and it is understood that it will reach the Big Sioux River in Dakota before winter; and another important line for military purposes is now under construction from Sioux City, Iowa, to Yankton, Dakota Territory.

The health of the troops in this command during the past year has been uniformly good, and, according to the report of the medical director of the department, better than for the previous year.

Owing to the excessive cold on the northern plains of the department, I would recommend that the quantity of fuel for troops be increased over the present allowance during the winter months. The present regulation allowance is not sufficient during the winter season, and owing to the small supply of timber on the reservations at most of the posts, it has been found impracticable for the troops to supply the deficiency by their own labor.

I would also recommend (owing to the severity of the climate) that buffalo overcoats be provided for the troops at each post—at least a number sufficient for guard purposes. We have now a few on hand at some posts, but recent requisitions for additional ones have not been filed.

The duties of the different staff departments at these headquarters have been promptly performed, and all practicable economy has been practiced in the administration of affairs in this command. Much embarrassment has been caused by the frequent changes of chief quartermasters of the department, four different officers having been on duty in that capacity during the last six months, which has led to some confusion in the accurate control of that department.

This report having been called for at an earlier date than is usual, is forwarded without awaiting arrival of reports of subordinate commanders, save that of Colonel George Sykes, Twentieth Infantry, commanding District of Minnesota; the others will be forwarded as soon as received.

Herewith I inclose the annual reports of the chiefs of the staff departments at these headquarters, together with certain other papers which give some information concerning the late and present Indian relations in this command.

I leave my headquarters this day on a tour of inspection along the line of the Northern Pacific Railroad, visiting the new posts of Cross and McKeen; thence via Missouri River to Sioux City, inspecting on

the route the posts of Fort Rice, Grand River, and Cheyenne agencies, Fort Sully, Lower Brulé agency, and Fort Randall, Dakota Territory. I expect to be absent upon this service about eighteen days.

I am, sir, very respectfully, your obedient servant,
 WINFIELD S. HANCOCK,
Major-General, United States Army, Commanding.

The ASSISTANT ADJUTANT-GENERAL,
Military Division of the Missouri, Chicago, Illinois.

P. S.—Since writing the foregoing, I have received a copy of a communication, dated September 19, 1872, showing that action by the Interior Department in reference to the sale and issue of arms and ammunition to Indians at the different trading-posts referred to in this report, and I deem it proper to file a copy of the same herewith, to show the action taken on the subject to this date.

Very respectfully, your obedient servant,
 WINFIELD S. HANCOCK,
Major-General, United States Army, Commanding.

The following papers accompany this report:

1. Annual report of acting assistant inspector-general of the department.
2. Annual report of the judge-advocate of the department.
3. Annual report of the chief quartermaster of the department.
4. Annual report of the chief commissary of subsistence of the department.
5. Annual report of the medical director of the department.
6. Annual report of the chief paymaster of the department.
7. Annual report of the engineer officer of the department.
8. Annual report of Colonel George Sykes, Twentieth Infantry, commanding District of Minnesota.
9. Letter of Colonel Stanley, (April 12, 1872,) giving substance of talk with "Spotted Eagle," chief of the Sans-Arc band of Sioux.
10. Telegram of Colonel Gibbon, (June 25, 1872,) giving available strength of cavalry and infantry for escort to expedition down the Yellowstone.
- 11 and 12. Telegrams of commanding-general Military Division of the Missouri, (June 29, 1872,) directing escorts to be furnished by July 20, 1872, to accompany two surveying parties of the Northern Pacific Railroad to the Yellowstone.
13. Department special orders, (No. 142 current series,) directing the supply from that command of the two escorts, in accordance with above telegrams, (11 and 12.)
14. Telegram of Colonel Gibbon, (July 24, 1872,) giving strength of cavalry and infantry in expedition.
15. Telegram from department headquarters to Colonel Gibbon, (July 25, 1872,) directing cavalymen whose terms expire in August and September should accompany the expedition.
16. Telegram of Colonel Gibbon, (July 27, 1872,) saying infantry command started that day, and cavalry leave July 28, 1872.
17. Letter from Colonel Gibbon, (July 30, 1872,) giving reason why expedition did not start on the 25th instant.
18. Telegram of Colonel Stanley, (July 31, 1872,) stating that he marches at 7 a. m. next day, and gives strength of command.

19. Telegram of Colonel Stanley, (August 7, 1872,) forty miles from Fort Rice.

20. Telegram of Major Baker, (August 15, 1872,) reporting attack by Indians on the 14th.

21. Telegram of Colonel Stanley, (August 24, 1872,) reporting attack by Indians on the 16th. He has directed commanding officers of posts in Middle District to take possession of arms, &c., in hands of traders.

22. Telegram of Colonel Stanley, (August 25, 1872,) saying engineers will be engaged one month west of Little Missouri. Asks that traders who sell rifles be stirred up.

23. Letter of Colonel Crittenden, commanding District of Montana, (August 29, 1872,) forwarding copy of letter of commanding officer Fort McKeen, of August 27, 1872, reporting attack of the mail party from that post, by Indians; and his letter to commanding officer at Otter Crossing, directing him to render any assistance in his power to commanding officer at Fort McKeen, if called upon.

24. Letter from department headquarters to Colonel Gibbon, (September 2, 1872,) acknowledging receipt of his letter of 19th ultimo, and directing him to make full investigation of the facts mentioned in that communication.

25. Letter of Captain Boyd, Seventeenth Infantry, (September 6, 1872,) giving an account of the attack on Major Baker, as related by Sioux Indians who were engaged in that fight.

26. Telegram of Colonel Gibbon, (September 7, 1872,) stating Major Baker reported his command on the 2d instant, on the Muscleshell, coming back, engineers declining to proceed farther than "Pompey's Pillar," considering escort too small.

27. Telegram of Captain Boyd, Seventeenth Infantry, (September 7, 1872,) says the Indians who were engaged in the fight with Baker have scattered, and were to re-unite with the Uncapapas, to attack Colonel Stanley. Several from that agency have gone to join the hostiles.

28. Division headquarters furnishes copy of Secretary of Interior's letter of September 19, 1872, inclosing copy of Commissioner of Indian Affairs' letter of September 17, 1872, recommending certain action for the suppression of the sale of arms, &c., to hostile Indians in Dakota and Montana.

29. Field return of expedition under Colonel Stanley, (July 25, 1872.)

30. Field return of expedition under Major Baker, (July 28, 1872.)

REPORT OF BRIGADIER-GENERAL POPE.

HEADQUARTERS DEPARTMENT OF THE MISSOURI,
Fort Leavenworth, Kansas, September 28, 1872.

COLONEL: I have the honor to submit, for the information of the Lieutenant-General commanding the division, my annual report of affairs in this department.

The report is necessarily, and, I trust, satisfactorily, brief, as I have no Indian hostilities, depredations, or disturbances of any moment to recount, and nothing except the relation of a very quiet and peaceful administration of my office.

INDIAN TROUBLES.

In the early spring some Kiowa Indians, seven in number, ran off the mules of a train between Camp Supply and Fort Dodge. A portion of the animals have been recovered, but a large part of them are still in possession of the Indians, with whom, as they are reservation Indians, and under the entire control of the Indian department, the military authorities are denied the right to interfere, and can neither punish such Indians nor use force to recover the public property so stolen.

The judicious and efficient management of Indian affairs at and near Camp Supply by Lieutenant-Colonel Davidson, Tenth Cavalry, in command of that post, has largely tended to avert hostilities and keep quiet among the Indians in that region.

Of course thousands of rumors, amounting at times to positive and detailed accounts of Indian depredations and murders, have, for reasons well understood here, been widely circulated, but have given little or no uneasiness in this department, from the fact that all post commanders have long since been instructed, upon the first inception of such rumors, to send a force to the spot promptly, to ascertain and report the facts. Nearly all such reports have been thus squelched at once, and the frontier settlements of Kansas have enjoyed an unprecedented season of quiet and prosperity. A large cavalry camp, occupied by most of the companies of the Sixth Cavalry, under Lieutenant-Colonel Neill of that regiment, was, early in the spring, established near Fort Hays, and companies from that command have kept the whole region north of the Arkansas River, and much of it between that river and the southern line of Kansas, thoroughly scouted during the whole summer. Robberies of stock have several times occurred in that region, but such acts being rapidly followed up by the cavalry, have, in most cases, been proved to have been committed by gangs of white thieves, who have been caught and turned over to the civil authorities, or by parties of Osage Indians, who were absent from their reservation hunting, it is understood, by permission of the Indian department. It seems inconsistent with any true policy, as it is undeniably a wrong to the frontier settlers, that Indians to whom reservations have been assigned, and from which in some cases actual white settlers in large numbers have been removed by military force, in order that the Indians might occupy the lands, should on any grounds be permitted to leave such reservation on pretext of hunting, and permitted to roam through sections of the country where they have no right to go, and which are properly and legally occupied by white settlers. Restrictions as to locality should be reciprocal in order to bear even the semblance of justice. If whites are forbidden to intrude on Indian reservations, it is their right with equal propriety to demand that the Indians be prohibited from intruding on lands which they either actually occupy, or which are theirs to occupy under the laws of the United States whenever they choose.

Most of the robberies, and all the anxiety and uneasiness in this department, have been occasioned by the presence and acts of these reservation Indians where they have no right to be, and I respectfully but most strongly represent that the practice of giving permission to reservation Indians, or any other Indians, to go into regions of country their title to which has been bought, and which are either actually occupied by white settlers or subject to their occupation at any time, is an unwise, if not illegal, discrimination against the whites, likely to create (as, indeed, it has created) bitter feeling, and which has occasioned

much wrong-doing on both sides. It is far better policy and wiser economy, if game be absolutely essential to Indian diet, to hire white hunters to furnish it from lands subject to white men's occupancy, than to allow Indians to intrude upon white men's lands, while white men are prohibited from setting foot on an Indian reservation. I trust sincerely that the practice of giving such permits to Indians to hunt will be discontinued in this department at least.

NEW MEXICO.

The reservation for the Apaches of Southern New Mexico, in the Tularosa Valley, has been located, and a military post established there. Many, if not most of these Indians have been placed upon it without serious difficulty, owing largely to the good management and wise action of Lieutenant-Colonel Devin, Eighth Cavalry, who was placed in immediate charge of the movement. Such of the Apaches as have remained away it is believed will soon be brought in, and a state of quiet secured in that part of the Territory hitherto unknown.

In the northwestern part of the Territory there was some dissatisfaction among the Ute Indians which threatened, at one time, to occasion serious trouble, but the prompt and judicious action of Major Price, Eighth Cavalry, commanding Fort Wingate, acting under the instructions of Colonel G. Granger, commanding the district, in co-operation with the Indian department, effected a peaceable settlement of the questions involved. In this place it is proper for me to state that much of the unusual freedom from Indian hostilities in New Mexico has been due to Colonel Granger, the district commander, whose sensible and discreet management of Indian affairs in his district has commanded my hearty appreciation and approval.

MILITARY EXPEDITIONS.

The only military movement in any force it has seemed judicious to make was a movement of some companies of the Eighth Cavalry, under command of Colonel J. I. Gregg, of that regiment, from their summer camp on the Canadian, near old Fort Bascom, along the eastern line of the Staked Plain as far as the sources of the Red River of Louisiana. This movement had in view very largely the purpose to put a stop to illicit traffic of New Mexican traders with the Kiowas and Comanches; a trade embracing exchange of powder and lead on one side for cattle and horses stolen in Texas by the Indians. I have directed that all such rascals from New Mexico, caught in this traffic, be sent to Texas, with the stolen stock, and turned over for trial to the civil authorities of that State.

RAILROADS.

The completion of the narrow-gauge road from Denver to Pueblo, Colorado, has changed our point for shipping supplies in wagons to New Mexico from Kit Carson to Pueblo—a great gain to us in many ways.

The Atchison, Topeka and Santa Fé road is now completed and running its trains to Fort Dodge, Kansas, which enables us to dispense with a large part of the wagon transportation, which has hitherto been a heavy expense in this department. With the exception of Fort Lyon and Camp Supply, every post in this department, east of New Mexico, is on a railroad, and there is little doubt that, by spring, the Atchison,

Topeka and Santa Fé road will be completed to Fort Lyon. Camp Supply is only eighty miles south of Fort Dodge.

MILITARY POSTS.

The military posts of Harker, Reynolds, and McRae have been abandoned this year, and, in my judgment, one or more of the posts in New Mexico could be given up judiciously as soon as shelter can be had for troops at points where military force is more needed and would be better placed. The great lines of railroad indicate pretty clearly what are to be thoroughfares across the country, and where settlements induced by them, and in want of temporary protection, may be found. I do not, however, in view of the scant appropriation for purposes of building, recommend any further changes this year.

I renew the recommendations of my annual reports for the past two years for building at Fort Leavenworth. If it were left to my judgment, I would concentrate here all the troops in this department east of New Mexico as winter quarters, and depend altogether upon summer camps, thrown out from here in the early spring, for all needed military protection of the Kansas frontier. As I have said many times, there is no danger from Indians in this region in the winter, and the summer camps, placed, if judicious, near where the present posts now are, would furnish, and furnish better and with more efficiency, the military protection now imperfectly supplied by the small posts.

Forts Larned, Dodge, and Lyon are substantial, well-built posts, and will last a long time; but Hays and Wallace are the frailest temporary structures imaginable. They were never fit in their best days for occupation during the severe winters of the plains, and are now nearly worn out. Another year will, I trust, see the end of them.

I beg leave to repeat here the opinion expressed in every annual report made by me since I have been in command of this department, that the abandonment of the numerous small posts, and the concentration of the troops at posts which shall contain at least one regiment, is demanded by every view of military efficiency in the protection of the frontier, by every consideration of wise economy, and by every necessity of discipline and well-being of the troops. From these large posts summer camps could be thrown out early in the spring, thoroughly to cover the whole frontier, and every man, except the small detachments, left to take care of the few large posts, would be available and in condition for immediate and efficient service. With the present system of small posts, the administrative machinery of each of which is nearly if not quite as large as would be needed for each of the large posts, we are not able, on the most liberal calculation, to put more than two-thirds of the force actually in the field.

Fort Leavenworth, with its large reservation, central location, and the abundant and cheap productions of the country around it, together with its immediate and rapid connections by rail with all parts of the frontier of Kansas and Colorado, is pre-eminently fitted for a large concentration of troops for service on this frontier, and should be enlarged accordingly, so as to be capable of accommodating at least two or three regiments. I have pressed this matter so often and so urgently for the past two years that it seems unnecessary further to pursue the subject here.

DESERTIONS.

While the number of desertions from the troops in this department has much decreased during the past year, they are yet numerous enough

to be the cause of dissatisfaction and uneasiness. The causes of desertion hitherto assigned need not be repeated; but I venture to suggest that, in the intervals of duty, the soldier needs more amusement, mental and physical, than is now possible for him to have. The first essential to contented service is some agreeable and useful occupation when not on actual duty, and it would be economy to furnish this in reason, even if it required a direct appropriation to do so. It can, however, be reasonably accomplished without additional expense; and I herewith present a plan for doing so, which I trust will be adopted. It was first proposed in a letter from me to the Secretary of War, part of which is herein quoted:

The desertions from the Army within the last two years have been so numerous as to be a subject of deep concern to the country, and to occasion much uneasiness and mortification to military commanders, who have been earnestly seeking a cause for it. I think it not useless to submit for your consideration a few remarks on the subject.

While, no doubt, the reduction of pay and the thousand of opportunities to better his condition, furnished to the soldier by railroad and other enterprises, have proved a great incentive to desertion, it is believed that such causes may be obviated, or greatly modified, by providing the soldier with some proper means of recreation or improvement. At present there is no provision of the kind, and the dry and monotonous routine duty of the soldier becomes wearisome to the last degree.

Such post-libraries, reading-rooms, &c., as existed before the war have all disappeared, and there cannot be collected under present regulations a sum at all sufficient to replace them. It follows, of course, that when the soldier is not actually engaged in the performance of some duty, he is without resource of any kind, and naturally takes to idling and complaining. Those at all inclined to drink become dissipated and worthless, are put into the guard-house, and sentenced by courts-martial to confinement of greater or less duration. Of course the routine duty they are thus debarred from performing must be done by the other members of the company, who have done no wrong, but who are actually punished by this extra duty for the sins of others. Of course this is a further cause of discontent.

The fine imposed on the soldier who sins, and whose confinement transfers his duties to the shoulders of the innocent, in no respect inures to their benefit, but is appropriated for the Soldiers' Home, in Washington, where few soldiers ever go, and which is already the richest institution in this country.

I see that about \$200,000 were collected last year from fines thus imposed, to be appropriated to the Soldiers' Home, which, from funds on hand and the interest upon them, has already an income far larger than its necessities. It is needless to say that such an arrangement is extremely distasteful to the Army.

I assume, as a matter of course, that it is the policy of the Government (as it is certainly common sense) to do everything that can reasonably be done, to satisfy the soldier with his lot. As a mere question of expense to the United States, it is certainly the true policy. A contented soldier will not desert, and will surely perform his duty better than one who is discontented.

This naturally leads me to what I wish to commend to your attention, viz: The propriety and good policy of devoting at least 50 per cent. of the fines collected from courts-martial sentences to the purchase of books, magazines, newspapers, &c., for the establishment of post-libraries and reading-rooms at the military posts in the Army. Such a disposition of the fines in question, would not impair at all the efficiency or comfort of the Soldiers' Home; would involve no increased expense to the Government, but would really save the United States many thousands of dollars now paid out for arrests of deserters, their confinement in penitentiaries, and the very great expense of so many courts-martial, and would, besides, go further than any measure I know, to arrest desertions, and render the Army more efficient, contented, and satisfactory. Whether it be in your power, without legislation, to make such use of the fund in question, I do not know; but, if it be, I may safely assure you that you can do an act of infinite advantage to the service, and one which, I am sure, will be unanimously acceptable to the Army.

The details of expenditure of this money for post-libraries, &c., and the regulations for the management of the fund, and the care of the buildings, books, &c., would easily be made.

If legislation be needed to accomplish the purpose, I respectfully suggest that it be asked for at the next session of Congress.

MILITARY PRISONS.

The necessity of military prisons for the Army, established and regulated on some well-considered system, becomes more apparent every day. In so large a military department as this, there are always as many as one hundred men, and sometimes more, undergoing sentences of confinement and labor of long duration. It is impracticable at frontier posts to execute such sentences, because the means of confinement are limited and insufficient, and because the garrisons of posts are either too small or too actively employed to permit the detail of the necessary guard. Such prisoners must, therefore, be sent elsewhere for the execution of the sentences against them. The guard-house at Fort Leavenworth is an unusually large and strong building, and it has been my custom to order the confinement in it of as many such prisoners as it can be made to accommodate—generally about fifty; but there still remains a large number, which, under existing circumstances, must be sent to one of the State penitentiaries—that of Kansas or Missouri.

While the United States is compelled to undergo the expense of clothing and subsisting such prisoners during their imprisonment in these penitentiaries, the public service derives no compensating benefit from their labor, which now inures to the profit of the States or the contractors. It should seem that, whatever benefit can be derived from the labor of such prisoners, properly and naturally should be for the use of the military department which is thus deprived of their services, and of the soldiers who are compelled to do the duty which they have disqualified themselves from doing. Certainly the Government, which, I believe, now pays about \$3,000 every year for supporting prisoners in the State penitentiaries, ought to derive some remuneration from their labor, and it is in this view that I respectfully recommend that the sum of \$10,000 be appropriated to enlarge the means at this post of confining prisoners sentenced to long terms of imprisonment and labor. It is central and well suited to the convenience of the frontier posts. The value of the labor of such prisoners now lost by their confinement in penitentiaries would, in three years, pay the cost of building such a prison here.

DEPARTMENTS OF THE GENERAL STAFF.

It is a pleasure, as well as a duty, to report that in the performance of my duties, I have received at all times the most cordial and valuable assistance from the officers of the general staff serving at these headquarters. The business of their several departments has been conducted with energy and ability, and the results are plainly manifest in the general condition of the department, and the economy and efficiency of its administrative departments.

To Lieutenant-Colonel R. Williams, assistant adjutant-general; Colonel N. H. Davis, inspector-general; Major M. R. Morgan, chief commissary subsistence; Major S. G. Swaim, judge-advocate; Major J. G. Chandler, chief quartermaster; Surgeon G. Perin, medical director; and Lieutenant E. H. Ruffner, Engineers, my thanks for this condition of affairs are specially due. I transmit inclosed the reports of these officers, of the business of their respective departments for the past year.

The indefatigable industry of Lieutenant Ruffner, united to his intelligent comprehension and systematic work, has largely added to an

accurate knowledge of the topography and general physical character of those portions of the department about which little was known, as well as large sections very inaccurately laid down on the present maps. It is hoped and believed that two or three more seasons of such active and thorough work will go far to complete with accuracy our maps of this region.

Second Lieutenant Philip Reade, Third Infantry, acting signal officer at these headquarters, has performed his duties with zeal and intelligence.

I submit herewith a roster of this department, and a return of the troops serving in it.

I am, colonel, respectfully, your obedient servant,

JNO. POPE,

Brevet Major-General, U. S. A., Commanding.

Lieutenant-Colonel J. B. FRY,

Assistant Adjutant-General Military Division of the Missouri.

REPORT OF BRIGADIER-GENERAL ORD.

HEADQUARTERS DEPARTMENT OF THE PLATTE,

Omaha, Nebraska, September 30, 1872.

COLONEL: In regard to affairs in my department since I assumed command, December 11, 1871, I have to report that during the winter, an unusually severe one, the troops were engaged in their regular duties at their stations, eleven in number, extending from this place to Nevada, and garrisoned by the Ninth, Third, and Fourteenth Infantry, and eight companies of the Second, and a detachment of the Fifth Cavalry.

During the prevalence of the heavy snows which began in October, and continued almost without intermission until April, the Union Pacific Railroad, which supplies all the posts in this department west of this place and east of Utah, was so much obstructed with deep snows, that for about a month at one time the cars failed to go through, and about ten trains were united with their freights, and passengers to work through the heavy snow-banks that filled many of the deep cuts on the high plateau east of the Green River basin; they drew rations from the military post of Fort Fred Steele (Colonel de Trobriand) when the supplies which had been accumulated by the railroad company in large, and it was supposed sufficient, quantities began to fail. It was a singular though cheerful sight for the passengers to witness the slow but sure mule-train working up through the snow to the relief of some twenty locomotives and their long train of cars out in the cold.

There was also danger of a famine at South Pass City, and among the miners of the vicinity, for the same reason, that the trains were all snow-bound; but Major Brisbin had enough at his post—Camp Stambaugh—to spare the citizens a supply of food until the roads were open.

A coal famine also occurred at the town of Cheyenne, and the necessities of the inhabitants had to be relieved from the surplus at the military post of D. A. Russell.

All these sales of supplies were approved by proper authority, as have been some issues which had to be made from posts farther east, to the half-starved bands of Sioux, who were making their way to their reservations from their winter hunt on the Republican.

As soon as the roads were open from the Pacific, the Third Cavalry,

which had been waiting at Benicia, arrived from California and took the posts which had been occupied by the Fifth, and the detachment of that regiment was sent to Arizona.

As spring advanced, some of the roving bands of wild Sioux, Cheyennes, Arapahoes, Minneconjoux, Utes, &c., began to move, and during the spring and summer the troops have formed seven scouting and observation camps to cover advancing settlements, and the operations of surveying parties, &c.

Lieutenant Wheeler, Clarence King, and Professor Hayden have received aid, and in three or four cases escorts from the military posts in this department, and several smaller parties of land surveyors have been provided with escorts where there was reason to apprehend attack.

There are five extensive frontiers to guard in this department: The east and west of the Great Utah Valley, which is surrounded by deserts and mountains, inhabited only by Indians; then coming east are the settlements extending from Fort Bridger to Wind River, also surrounded by a wide scope of Indian country; thence coming farther east, over the plains occupied by roving and wild bands, until the settlements which are advancing west up the tributaries of the Missouri are reached. Besides these, there is a line of settlements and small towns along the Union Pacific Railroad, and all of these are more or less sensitive in proportion to the scanty numbers of settlers and their remoteness.

In Southeastern Utah, Wind River Valley, along up the Republican and Loup Fork, and on the streams near the North Platte, heading in the Black Hills, the settler's nearest neighbor is sometimes eight, ten, or twenty miles distant, and every man plows and mows with his rifle in his hand or at his back. Stock to be safe have to have armed herders with them, and with such an extensive district and series of almost helpless frontiers, and such a severe winter to stimulate the hunger of the Indians, the wonder is that so little harm was done by them. The list of casualties foots up about as follows:

In Wyoming: Three men killed, and about twenty-seven mules and horses stolen.

In Nebraska: One soldier killed, three or four small herds of cattle taken.

In Utah: Two whites killed, and perhaps two hundred head of stock stolen by hungry reservation Utes, whose reservation (almost a desert south of the Uintah Mountains) affords them no game; and not enough food having been provided there, and being accustomed to Utah Valley, from which they had been taken, they returned and continued to prey on the Mormons, until troops were sent after them, when they returned to their reservation on promise of being fed.

In every case, except those named below, the Indians committing the depredations have been pursued and, in some cases, the stolen stock recovered, and four or five Indians have been killed in these pursuits. When the depredation has occurred near the extensive reserve Indian district north of the North Platte, and the Indians have fled across that river and taken refuge among the numerous bands there provided for by the Government, and from whose country white men are by treaty specially excluded, the Indian Department has not deemed it politic to allow a pursuit, which, if attempted at all, would have required a large force, and perhaps led to a war in which peaceable and innocent Indians might have suffered. While this conclusion may be correct, and is humane to the Indians, the settlers, whose stock has been stolen and herders killed, might see it in that light if they were paid for their losses out of the Indian annuities, as is, I believe, provided for by the same

treaty which authorizes these Indians to hunt anywhere in the white settlements south of their own lands.

In regard to discipline, the troops of nearly all the posts in this department, when not out scouting, escorting civilian parties, or building posts, have been, since the winter, regularly drilled, and target practice held weekly. Considerable improvement in the skill of the men has been the result, though while in late years such continual improvement has been made in the arms issued to the soldier, until his rifle has become a delicate and valuable instrument, comparatively little care is taken that the hire of the man to shoot this highly-improved arm has increased with the character and expensiveness of his arm and current rates of wages on the frontier, so that while we have a much nicer and more different arm to handle than we used to have, I rather think we have a much less intelligent soldier to handle it.

The first sergeant of a company of troops is expected to keep all the books, call all the rolls, attend all the drills, be responsible for all the company arms, never get drunk; he and the other sergeants have entire charge of the men in quarters, and frequently of scouting and escorting parties, and are expected on those occasions to do an officer's duty, and the duty-sergeant's pay, \$17 per month, only exceeds by a few cents per day that of the private soldiers, (with whom they have to eat and sleep, because they cannot afford a separate mess.) Sergeants of engineers and ordnance, whose duties are not half as dangerous and not more responsible, receive double the pay. It is difficult to understand the reason of this, but the result of poor pay is poor sergeants, and, as a rule, the line does not get non-commissioned officers who command the respect or obedience of the men.

Desertions, it is true, have somewhat decreased since the new pay-bill went into operation, but if a sergeant was paid as in the ordnance or engineers, the line would probably secure the services in that grade of intelligent young Americans, especially if there was a prospect that occasionally one would be commissioned.

There are only eight companies of the Second Cavalry, averaging about 70 men each, in this department, and there have been 165 desertions among them in eight months of this year. In one regiment of infantry there were in the year ending January, 1872, a little over 290 recruits sent them and a little over 300 desertions, and but few of these men are ever apprehended, because the trifling reward offered a civilian for the deserter's apprehension and delivery is not enough to pay expenses to the post and home if the deserter gets fifty miles away. Some of this wholesale desertion is doubtless due to incompetent company commanders, who turn the discipline of their men over to harsh and intemperate sergeants; but the reduction in the number of desertions since the small increase in the man's pay indicates that a still further increase would be attended with similar good effect.

The law directing post-schools at military posts has been generally carried out in this department. It is proposed to establish a system of instruction for such schools as soon as the summer and fall scouts are over.

Schedule marked A shows the operations and movements of troops as far as reported; B, the casualties occurring in regiments; C, the present position of troops in the Department. It will be seen by the latter that four companies of the Eighth Infantry have been recently stationed at Beaver, Southern Utah, where barracks for the soldiers to the amount allowed by law, \$20,000, are in process of erection. This sum is entirely inadequate to build store-houses, hospital, officers' quarters, a guard-

house; the officers will have to spend the winter (which at that elevation is severe) in tents, and I recommend an appropriation of at least \$60,000 for the erection of proper quarters, store-houses, &c., at that place.

The necessity for a military station in that district of country is due to the rapid increase of valuable mineral discoveries in the sterile mountains of Southern Utah, which discoveries are generally remote from each other and from the Mormon settlements. To develop these and discover others, the small bands of miners and prospectors should have some military posts near, where the United States flag is kept flying, and where they will feel that they have friends who will stand by them; and from which posts frequent expeditions can be made to insure quiet and cover their advance. I also think that a military station of two companies of cavalry for the same reason is now needed at Saint George's or Kanab, in Southern Utah, where the United States Government and its flag are scarcely known.

I also have to request that a sufficient appropriation be asked to build a two-company post on the Upper Republican, where rapidly advancing settlements are pushing out, and where the Indians go in large numbers annually to hunt. Thirty thousand dollars will, I think, cover what is needed there. (See letter of Mr. Royal Buck, appended, marked D, which shows how the settlers there feel about it.)

The officers' and men's quarters at Camp Douglas are old and dilapidated, built about eleven years since, of logs resting on the ground. They are now, especially those of the men's, scarcely habitable on account of the logs in that damp winter climate having rotted. New quarters of stone can be erected at comparatively a small expense if as the stone is convenient and could be quarried and brought in by the soldiers for this purpose. I have to ask an appropriation of \$30,000; the probable unsettled condition of affairs there, I think, will make the post necessary for many years, and hence the call for good and sufficient quarters.

I am, colonel, very respectfully, your obedient servant,

E. O. C. ORD,

Brigadier-General, Commanding.

Lieutenant-Colonel JAMES B. FRY,

Assistant Adjutant-General United States Army,

Headquarters Military Division of the Missouri, Chicago, Ill.

REPORT OF BRIGADIER-GENERAL AUGUR.

HEADQUARTERS DEPARTMENT OF TEXAS,

OFFICE ASSISTANT ADJUTANT-GENERAL,

San Antonio, Texas, September 28, 1872.

COLONEL: I have the honor to submit the following report of military operations within this department since I assumed command, January 29, 1872:

After due examination and consideration, I deemed it advisable to make considerable changes in the station of certain companies and regiments, with a view of getting companies of the same regiment together, or as nearly so as practicable, and to bring more cavalry to the line of the Rio Grande, where it was thought it could be made more useful. These changes were made with our own transportation.

Being apprehensive that the system of subposts found in operation (with their days and manner of scouting prescribed in orders) might degenerate into mere routine, I thought it better to substitute for it another with a more direct responsibility, as follows:

The orders now existing in this department establishing subposts, and prescribing the number of troops at each post to be engaged in scouting, are rescinded, and the following substituted therefor:

Every commanding officer will be held responsible that within the limits of his post, as prescribed in General Order No. 6, from these headquarters, of 1871, the troops under his command are employed to the extent of their ability in giving protection to exposed settlements and routes of travel, and in guarding against Indian incursions; and in case the latter do occur, that they be not content with a mere formal pursuit of a few days, then losing trail and returning, but see that a rigorous, determined, and continued effort, even to the extent of privation to men and horses, if necessary, be made to overtake and punish the marauders. To this end, they will establish such camps and stations on mail-routes and near settlements, and direct such scouts as, in their opinion, will most surely aid in accomplishing the desired objects.

If this system has not been altogether successful in repressing Indian raids, it is not the fault of commanding officers or that of the troops. They have all shown great zeal and intelligence in endeavors to capture and to punish the raiders.

The Texan frontier settlements suffering most from incursions of hostile Indians are those on the north, extending from Fort Richardson by way of Forts Griffin and Concho, and toward Fort Stockton to the Pecos River, a distance of over four hundred miles; and those on the west, down the Pecos and Rio Grande Rivers as far as Fort McIntosh, about the same distance.

It will be observed that the northern line is directly opposed by the Indian Territory, where are collected all the quasi friendly tribes, and by the Staked Plains, the home and hiding-place of all the marauding bands who refuse to go upon reservations.

There is free and unrestrained intercourse between the two classes of tribes, and it is well known that the Kiowas of the first class have been connected with the latter in most of the outrages, maraudings, and murders during the past summer.

The Staked Plains and Indian reservations afford, by short lines, refuge and security to these outlaws, and to their plunder.

The western line is exposed to outrages from bands of Indians permanently located in Mexico, and others who make of Mexico a base for operating against our frontier settlements, and by short lines, a refuge from pursuit, and a market for their plunder.

In view of these favoring surroundings it is nearly impossible for troops acting simply on the defensive as it were, and limited in pursuit by Mexico on one side and reservations on the other, to prevent these raids upon settlements, or to punish the marauders.

In addition to these Indian outrages the frontier Texan settlements are exposed to another enemy almost as fatal to their prosperity as the Indians—the cattle-thieves from New Mexico, on the northern line, and the cattle-thieves from Mexico, on the western line.

The great cattle-ranges of Western Texas lie near the Rio Grande, which is a mere mark of boundary without being in the least an obstruction to the operations of the thieves. It is an obstacle only to the troops and others who follow them, and endeavor to recover their property. The cattle-thieves from New Mexico are in league with the Indians of the Staked Plains, to whom they supply arms and ammunition and whatever else they require.

On the 28th March, Sergeant Wilson, of Company I, Fourth Cavalry, sent out from Fort Concho in pursuit of a (supposed) body of Indian

marauders, overtook them and had a brisk little fight, killing 2, wounding 3, capturing 1. This prisoner proved to be a New Mexican, and his account of himself, in brief, was that he was one of about fifty men from New Mexico, who were regularly employed to come to Texas to steal cattle. He gave the name of his employer and the wages he was to receive; mentioned the camps of Indians on the road who were working in concert with them, and related his operations generally to day of his capture. He stated what was hardly credited, that there was a good wagon-road across the Staked Plains, with plenty of permanent water and grass, and that all the stolen cattle were driven over it to New Mexico. I directed measures to be taken to verify as far as possible his statement. A party was sent from Concho, which, under his guidance, found, on the headwaters of the Colorado, the large Indian camp he spoke of, but abandoned, and evidences of large numbers of horses and cattle having been driven that way.

With a view of breaking up this cattle-stealing, and stopping incursions of hostile Indians along the northern frontier, I directed, in May, Colonel Mackenzie, Fourth Cavalry, to establish a camp of cavalry and infantry on the Fresh Fork of the Brazos, from which his cavalry should operate in pursuit of hostile Indians.

Colonel Mackenzie had the New Mexican as a guide, and in his operations discovered the road, which he (the guide) had passed over on his way from New Mexico. Its appearance indicated that large herds of cattle had passed over it, though, from recent rains, it was impossible to judge how long before. Colonel Mackenzie determined, very properly, to follow it, to find its termination, and possibly to recover some of the cattle. It led him directly across the Staked Plains, where he found plenty of water and grass, to near Alamo Gordo, in New Mexico. After striking the settlement it gradually broke up into small trails that promised no result from further advance. He endeavored to find the parties charged by the guide as being engaged in this traffic, but they could not be found. They had probably left, he reports, to escape capture by a party of citizens who were arresting cattle-thieves, and taking possession of stolen cattle.

On his return Colonel Mackenzie took the route from Fort Bascom to head of Red River, thence to his camp on Fresh Fork of Brazos. Of this last route he says:

This route has permanent and excellent water across the plains, and no distance of more than 30 miles between water. All the water runs into Red River, the Palo Duro being undoubtedly the Upper Red River. The trail I took in going across is more dependent on rain, but the Palo Duro trail has permanent spring-water. There is good water and grass by both routes, they being in almost every respect better than the Pecos trails, and could be made safe to legitimate cattle-drovers.

This is the first instance, in my knowledge, where troops have been successfully taken across the Staked Plains. This fact, that troops can be so moved, and the general knowledge of the country, and the specific knowledge of the routes and *modus operandi* of the cattle-thieves, obtained by Colonel Mackenzie, I regard as very important, and well worth the summer's labor. Maps and itineraries are being prepared by him, and will be completed when his command comes in, (by November 1.) As soon as received they will be forwarded.

So far he has failed to find any Indians. He appears to think they have gone north of Red River, to keep out of his way. It is believed, too, that the Apaches, Comanches, and other bands recently gone to Mexico, are the bands who have also been driven from that country by Mackenzie's operations there. In March last the President directed

that all persons in the Indian Territory south of Kansas and west of Arkansas and Missouri (except such as bore authority from superintendent of Indian affairs in the Territory to remain, and such as are actually in good faith engaged in building and operating the railroads now being constructed through the Creek and Choctaw countries) be at once removed; and that a sufficient military force be detailed for the purpose. The carrying out of this order was confided to Colonel Grierson, Tenth Cavalry, under the following instructions:

You will communicate at once with the superintendent of Indian affairs for Indian Territory, or if that is impracticable, with the local agents, and obtain from them the names and location of the persons authorized to remain, and also the names and location of unauthorized intruders, whose removal is ordered. To these latter you will cause notice to be given of the order of the President for their removal, and of your instructions for its enforcement; and, fixing a reasonable time, you will inform them that at the expiration of that time they must leave the Indian Territory; if not, that force will have to be used to effect this removal. They should be impressed, too, with the fact that this order has been given after a great deal of discussion of the matter in the public newspapers and in Congress, and that there is not the slightest chance of its being recalled. It is hoped this will be sufficient to induce a general acquiescence, and that nothing more than a mere show of force will in any case be necessary. If, however, unfortunately, they will not listen, and quietly retire, and it becomes necessary to use force, you are expected to do so, and in such a way as will effectually show there is no hope but in compliance. At the same time you will be careful to impress upon all engaged in this duty that no unnecessary violence is to be exercised toward these people, nor are they to be subjected to any exactions or losses, nor made to undergo any hardships not inseparable from a thorough execution of the order. It is barely possible there may be attempts to organize a resistance. You should take measures to have yourself promptly informed of every effort of this kind, and in every case your force in hand should be sufficient to render any resistance hopeless.

Under his judicious management the removal has been effected without trouble or a single complaint, so far as I have heard.

In consequence of this duty, and others connected with troubles on the line of the Mexico, Kansas, and Texas railroads, it was found necessary to re-occupy Fort Gibson. Two companies of the Tenth Cavalry, and two companies of the Twenty-fifth Infantry, now occupy that post. It is doubtful if there are sufficient quarters for these troops and officers. I shall, however, visit that post early in November, and determine the number of troops necessary to be retained there. It is believed that one company at least can be sent to Fort Sill for the winter.

To remedy as far as practicable irregularities on the Rio Grande frontier the following instructions were issued to commanders of posts along that line:

Numerous reports, official and otherwise, have reached these headquarters of irregularities along the Rio Grande frontier. It is stated that parties of Mexicans, sometimes armed, cross to this side, steal cattle, and commit other crimes, and that parties of Mexicans living on this side, quasi citizens of the United States, also cross to the Mexican side and commit depredations there. These irregularities are believed to be mostly due to the condition of revolution in which the Mexicans find themselves at present. The defeated bands of either party seek safety by crossing the river, where they watch for a favorable opportunity to return—frequently joined by friends from this side.

But, whatever the reason, a vigorous effort must be made to save our frontier from becoming a theater of robberies and a refuge for armed bodies of Mexicans on one side, or a base for organizing offensive operations to be carried on within the limits of a friendly power on the other.

All the cavalry that can be spared from other posts has been ordered to Fort Brown and Ringgold Barracks. This cavalry is not intended for duty at those posts, but for service in watching and patrolling the river to prevent violations of our territory by armed bodies of any description from either side the river, and to afford protection to our revenue officers while engaged in the execution of their duties.

The commanding officers of all posts on the Rio Grande will cause their troops to be vigilant, to find out and capture and disarm, and turn over as prisoners to their respect-

ive posts, any armed body of Mexicans found on our soil; as also armed bodies of men on our side who contemplate making Mexico the scene of warlike operations.

The commanding officer of Fort Brown, with the company of Fourth Cavalry *en route* to his post, and the company of infantry, which he is authorized to mount, is expected to do this as far up the Rio Grande as Ringgold Barracks.

The commanding officer Ringgold Barracks, with the company of Ninth Cavalry under orders to report to him, is expected to do this service as far up the river as the San Juanito.

The commanding officer Fort McIntosh, from the San Juanito to Kingsbury's Rapids.

The commanding officer Fort Duncan, from the latter point to any point above where he learns of any cause for action.

The limits of operations given above are for general guidance. They will not be observed when opportunity occurs to either command to accomplish anything by going beyond them.

I am assured that the action taken by officers in pursuance of these instructions has greatly diminished the irregularities complained of, though not by any means effectually stopping them. It is believed they never can be stopped without radical changes in the character of the Mexican border population.

The commanding officer of government forces in Piedras Negras, Mexico, directly opposite to Fort Duncan, Texas, having been for some time besieged by superior revolutionary forces, abandoned that place on the night of March 1, and brought all his force and arms to Fort Duncan and surrendered them to the commanding officer. Having been disarmed they were disbanded.

Some time after an attempt was made to re-organize this force on our side the river for purpose of recrossing into Mexico. Some arms and ammunition and a number of recruits were obtained. Captain Meyer, Ninth Cavalry, commanding at Fort McIntosh, hearing of this, proceeded to the camp, and arrested all the parties—seven officers and thirty-seven privates.

The commander, with a large part of the command, had crossed the Rio Grande the night before. Returning to this side a few days after, he was also arrested by Captain Meyer, and sent with the other officers to their headquarters, where they were held subject to the civil authorities for breach of neutrality laws; the privates were released. But as the civil authorities failed to take any action in their case, I was instructed to release them on their parole to appear whenever called for. Up to this time they have not been called for by the civil authorities.

I do not think that Forts McIntosh and Quitman are of sufficient use to warrant their retention as military posts. McIntosh is too remote from the Nueces settlements to be of any protection to them, and as a mere point to be held on the Rio Grande is of no particular value. A company of cavalry encamped near the settlements on the Cariso would be of practical service to them. Having it changed frequently from Fort Clark, no quarters need be built, as in case of very severe weather it could be brought into the post. Quitman appears of no value except as a point on the mail route to be protected, and this could be done by a detachment from Fort Davis quite as well, and thus save all the surroundings of a post. Or one company might be kept there detached from Fort Davis, to be changed frequently—Fort Davis to be considered as its post. I respectfully recommend that both these posts be abandoned as military posts.

The great extent of country covered by military posts in this department, and the means of communicating between them limited generally to wagons, renders the regular payment of the troops a matter of great labor and much time. With our limited number of paymasters, it was found impracticable to do it without a change of system. On the rec-

commendation of the chief paymaster, the following arrangement was made:

I. The payment of troops in this department will, until further orders, be made under the following directions and assignments of paymasters:

Major E. D. Judd to be stationed at San Antonio, Texas, reporting to the chief paymaster for such duty as may be assigned him.

II. Major George E. Glenn to be stationed at San Antonio, Texas, and is charged with the payment of the troops at Fort McIntosh, Ringgold Barracks, Fort Brown, and Brazos Santiago.

III. Major J. W. Nicholls to be stationed at Galveston, Texas, and is charged with the payment of the troops at Forts Richardson, Griffin, Sill, and their sub-stations.

IV. Major P. P. G. Hall to be stationed at Fort Concho, Texas, and is charged with the payment of the troops at Forts Concho, McKavett, Clark, Duncan, and their sub-stations.

V. Major W. P. Gould to be stationed at Fort Stockton, and is charged with the payment of the troops at Forts Stockton, Davis, Quitman, Bliss, and their sub-stations.

Under this arrangement the troops have been regularly paid. For the payment of troops at Fort Gibson, we have been indebted to a paymaster from Department of the Missouri. The completion of the Texas Central, and Mexico, Kansas, and Texas roads in a very short time will enable us to dispense with this arrangement, and do all of our own work.

The transportation of supplies, almost entirely by wagons, to the various posts scattered over this immense department, is a matter of serious importance, and of great difficulty. The contracts for this service have been made this year at what are regarded as reasonable rates, and lower than those of last year.

It is believed that by adopting a modified schedule of routes, which will be submitted in time, that another year this work can be simplified, and be procured at still lower rates.

The progress of railroads in this State will assist in this at present, and in a few years will entirely change the present system.

No complaints have thus far reached me of any failure of contractors to deliver supplies in time.

To prevent, as far as practicable, the shipment of imperfect stores, I have given the following instructions to all concerned:

The great expense attending the transportation of stores in this department renders it very important that only such as are in perfect condition for use be transported.

Hereafter, when supplies are to be shipped for use of troops from any supply depot in San Antonio, or from any post, they will first be carefully inspected, and none sent that are not perfect in quality and condition. Original, or other packages, the condition of whose contents is not fully known, will not be sent without the prescribed examination. Stores unfit for use should be detected at the depots and inspected, and, if necessary, condemned and disposed of there, and the Government saved the useless expense and trouble of their transportation to posts where they are of no use, and where the final disposition of them entails additional expense, and often very great inconvenience.

The difficulties and complications arising from the anomalous tenure of the sites of all of our military posts, has been fully reported upon by former commanders of this department, and is familiar to all. I only refer to it here to state that there is no diminution of the troubles connected therewith.

The Tenth Infantry has been, for nearly four years past, stationed on the Lower Rio Grande, and the men were suffering a great deal from the effects of that debilitating climate. I have given orders for it to change stations with the Twenty-fourth Infantry. The change is now being effected gradually, as we use our own transportation.

The labor and privations of the troops in this department are both severe. Much of the privation is due to the effects of climate, which render it impossible to grow fruit or vegetables at many of the posts,

and prevent their being supplied from the depot, as such articles, and many other essential small-stores, spoil *en route*.

The cavalry particularly are constantly at work, and it is a kind of work too that disheartens, as there is very little to show for it. Yet their zeal is untiring, and if they do not always achieve success, they always deserve it. I have never seen troops more constantly employed. The recent legislation of Congress in the interest of the enlisted men of the Army, will have, I believe, a very happy effect upon that not wholly appreciated class, and render them more zealous, if possible, in performing their arduous and thankless labors.

The officers of the general staff on duty at these headquarters are efficient and faithful officers, and to them, as also to my personal staff, I am greatly indebted for cheerful and ready assistance in every effort for the public service.

I respectfully inclose a statement of all Indian depredations that have occurred in the department thus far reported, a tabular statement of expeditions and scouts, a statement of the movements of troops, and a synopsis of labor performed.

I am, colonel, very respectfully, your obedient servant,

C. C. AUGUR,

Brigadier-General, U. S. A., Commanding.

Colonel JAMES B. FRY,

Assistant Adjutant-General, Headquarters Military

Division of the Missouri, Chicago, Illinois.

REPORT OF MAJOR-GENERAL MEADE.

HEADQUARTERS MILITARY DIVISION OF THE ATLANTIC,
Philadelphia, Pennsylvania, October 1, 1872.

SIR: In conformity with the instructions of the General-in-Chief, I have the honor to submit for his information the following report of the operations of the troops in this division since the date of the last report, viz, October 24, 1871.

The Military Division of the Atlantic is formed by the Departments of the East and of the Lakes, and geographically extends from the west end of Lake Superior to Eastport, Maine, and from the latter post to the Capes of Virginia.

The troops located therein consist of 4 companies of engineers, 31 batteries of artillery, 13 companies of infantry, 12 detachments of ordnance, garrisoning 23 posts, exclusive of arsenals.

The changes in the geographical limits of the division and of the troops stationed therein have been during the past year as follows:

Soon after the date of my last report, the State of North Carolina was transferred from the Department of the East to the Department of the South, and with it the troops then on duty in the State, viz, one company of cavalry and seven batteries of artillery.

On November 2, 1871, under the orders of the War Department, four companies of the Eighth Regiment Infantry, under a field officer, were transferred from the Department of the East to the Military Division of the Missouri, and on July 5, 1872, the remaining companies of the regiment, together with the headquarters, were transferred to the same division.

The only movements of the troops in the division during the year

have been the sending on May 12 last, to Houghton, Michigan, of parts of four companies of the First Infantry, on the requisition of the governor of the State, approved at Washington, to aid the civil authorities in the suppression of disorders in the mining region.

The following changes of stations of troops have also been made: Battery F, Fourth Artillery, from Fort Foote to Fort Washington, Maryland; Battery M, Fourth Artillery, from Fort Washington to Fort Foote, Maryland.

In September last, Fort Washington, Maryland, being required by the Engineer Department, its garrison, Battery F, Fourth Artillery, was transferred to Fort McHenry, Maryland.

I transmit, herewith, the reports of Brigadier-Generals McDowell and Cooke, commanding respectively the Departments of the East and of the Lakes.

I also forward the reports of the several chiefs of staff at these headquarters.

I beg leave to concur with the recommendations contained in the report of Brigadier-General Irvin McDowell, of the urgent necessity for the establishment of a penal post, where prisoners sentenced by general courts-martial to imprisonment and hard labor can not only be properly punished, but where measures can be taken to reform those capable of reformation and restoration to the service, and the service purged of those proved to be incorrigible. In connection with this subject, attention is invited to the report of Brigadier-General P. St. G. Cooke, who fully sets forth the evils arising from having no proper place to send prisoners, and also states that, in case some such place is not provided, the prisons at the several posts in his command will have to be enlarged.

I beg leave also to invite the attention of the General-in-Chief to the recommendation made some time since, that an appropriation be asked for to erect suitable barracks and quarters at David's Island, in New York Harbor. Last November twelve months, when the Eighth Regiment of Infantry was ordered to New York, preparatory to going west, there were no quarters that could be assigned but the unsuitable remains of former hospital, then standing on David's Island; these were repaired and put in as good condition as possible, and were occupied during the time the regiment remained. These emergencies of sudden and unexpected concentration of troops, and the occasional necessity of removing garrisons in the harbor and for repairs of the works, or for sanitary reasons in case of epidemics, render necessary additional quarters in the harbor over and above those supplied by the regular works, and as the Government has purchased David's Island, and it is favorably situated both as regards its being supplied and sanitary condition, I hope no time will be lost in erecting on it suitable quarters for officers and men.

Very respectfully, your obedient servant,

GEO. G. MEADE,
Major-General Commanding.

The ADJUTANT-GENERAL OF THE ARMY,
Washington, D. C.

REPORT OF BRIGADIER-GENERAL McDOWELL.

HEADQUARTERS DEPARTMENT OF THE EAST,
New York City, September 30, 1872.

SIR: In obedience to the instructions of the major-general commanding the division, conveyed in your letter of the 14th instant, I have the honor to submit the following report of operations in this department during the year ending September 30, 1872.

October 10 and 11.—Pursuant to instructions from Major C. H. Morgan, Fourth Artillery, commanding at Raleigh, North Carolina, Batteries "G" and "K," Fourth Artillery, rejoined their respective stations, (the former Fort Johnson, the latter Fort Macon,) from detached service in Robeson County, North Carolina.

October 17, 1871.—In compliance with instructions from the War Department of October 11, Captain H. W. Closson, First Artillery, with three companies of the First Artillery from Fort Hamilton, one from Fort Wardsworth, and two from Fort Wood, New York Harbor, and Colonel Bomford, with the Eighth Regiment of Infantry from David's Island, the whole under command of Colonel I. Vodges, First Artillery, proceeded to Brooklyn, New York, to assist Supervisor S. B. Dutcher, Internal Revenue Department, in the execution of his duties. The troops, after performing in a creditable manner the duties assigned them, returned to their respective stations in the evening, with the exception of one company of the Eighth Infantry, which remained at the navy-yard in charge of the captured property until October 19.

November 1.—The State of North Carolina was transferred to the Department of the South by General Orders No. 66, War Department, Adjutant-General's Office, November 1, 1871.

November 2.—In pursuance of instructions from the division commander, four companies (D, E, G, and I) of the Eighth Infantry, under Major J. D. Wilkins, Eighth Infantry, left David's Island, New York Harbor, for Chicago, Illinois, in the Military Division of the Missouri.

November 6, 7, and 8.—In pursuance of instructions from the War Department, based on the representations of the Secretary of the Treasury as to the possibility of there being a riot in New York City during the November elections, the troops at Forts Hamilton and Wood, New York Harbor, were held in readiness to come to New York at a moment's notice, with a view to protecting the treasure in the office of the Assistant Treasurer of the United States. No occasion arose for the use of the troops.

December 12.—I inspected the post of Fort Wood, New York Harbor.

February 12, 1872.—The remains of Brigadier-General Robert Anderson, United States Army, were brought to New York City from Fort Monroe, Virginia, and were deposited temporarily in the Marble Cemetery, Second avenue.

March 24 and 25.—I inspected Forts McHenry, Foote, and Washington, Maryland.

April 3.—The remains of Brigadier-General Anderson were taken from the Marble Cemetery, Second avenue, New York City, to the foot of Thirty-fourth street, North River, and placed on a steamer for West Point, the place of final interment. Light Battery K and Batteries E and H, First United States Artillery, several regiments of the National Guard, State of New York, civic societies, &c., acted as an escort on the occasion.

April 25.—I inspected Fort Monroe, Virginia.

May 11.—I inspected Forts Hamilton and Wadsworth, New York Harbor.

June 19.—In compliance with instructions from the War Department, Batteries M and F, Fourth Artillery, stationed respectively at Fort Washington and Fort Foote, Maryland, exchanged stations.

During the months of July and August I inspected the eastern posts of the department and the post of Plattsburgh Barracks, New York.

July 5.—In obedience to orders from division headquarters, the headquarters and companies A, B, C, F, H, and K, of the Eighth Infantry, stationed at David's Island, New York Harbor, left that post for the Military Division of the Missouri. The post remains in charge of an agent of the Quartermaster's Department.

September 16.—In compliance with instructions from division headquarters, Battery F, Fourth Artillery, left Fort Washington for Fort McHenry, Maryland. The former post is now in charge of the Engineer Department.

As the officers at Plattsburgh Barracks are much crowded in their quarters, and may become so much so, when the northern portion of the reservation at that place is set apart for civil purposes, as to make it necessary to hire quarters in the village, at a great distance from the men, I have to recommend that the battery of the First Artillery, now there, be transferred this autumn to New York Harbor, in order to give another battery to the extensive and important works on Staten Island. These works will soon have sufficient quarters for this addition, which they much need.

A recent visit to Halifax, and to the British troops stationed there, has confirmed me in the opinion I have heretofore expressed in my reports, that in the manner of enforcing discipline we are much behind the British service. I find that, while their soldiers are worse paid, worse fed, and worse clothed, their punishments are milder and their discipline much better than with us.

Much of this difference between us, in the latter particular, is, I think, beyond a question due to their system, and to our want of one, in the matter of military punishments. This subject has been already before the War Department, and by it submitted to Congress, and I wish to add here but one additional remark to what I have before said on this subject; that is, that while their system is more readily and more perfectly carried out by appropriate buildings, it is not dependent upon them. At Halifax the military prison was in an old frame building of but little value. I am sure, the *system*, as far as it is applicable, can be readily adopted in our service at comparatively little cost, and, by authority of the War Department, without further legislation.

I inclose herewith a return showing the present distribution of the troops in the department; also, the reports of the several chiefs of the staff departments at these headquarters, exhibiting in detail the operations of their departments during the past year.

Very respectfully, your obedient servant,

IRVIN McDOWELL,

Brevet Major General, Commanding Department.

The ASSISTANT ADJUTANT-GENERAL,

Headquarters Military Division of the Atlantic,

Philadelphia, Pennsylvania.

REPORT OF BRIGADIER-GENERAL COOKE.

HEADQUARTERS DEPARTMENT OF THE LAKES,
Detroit, Michigan, September 27, 1872.

SIR: I have the honor to report, as follows, the operations of this military department in the last year.

No change has taken place since my last annual report in the stations of the First Infantry and three batteries First Artillery, which constitute the military force of the department.

The northern part of this State, but especially the great promontory into Lake Superior, is a sterile copper and iron mining region; its chief population miners—many of these rude and ignorant foreigners; the civil authorities are feeble, and there is no militia organization in the State.

In May last at least 1,500 of these miners, in the vicinity of Houghton, combined in a “*strike*,” they became nearly all armed, and at last not only defied the civil authorities, but rescued prisoners, disarmed the sheriff’s posse, and threatened the peaceably disposed. The governor of the State, presenting to me official proofs of this state of things, received by telegraph on May 11, made very urgent application for military assistance. The emergency appearing great, I determined to give the instant aid of a military posse.

Accordingly troops were ordered, and were in a few hours in motion; parts of four companies, First Infantry, from Forts Wayne, Gratiot, and Brady, all under command of Captain K. Bates. He reached Houghton May 16, and, accompanying the sheriff, made a night-march, and reached the Calumet and Hecla mine, the seat of disorder, very early in the morning. This demonstration proved sufficient; and in a short time a large procession of miners, headed by a band of music, approached with the men for whom warrants had issued in front, and these surrendered themselves to the sheriff.

After a few days, when everything was quiet, the battalion was remanded to their several stations, the two companies of Fort Wayne arriving June 2.

Captain Bates praises in his report the “*excellent quiet and dignified conduct*” of his men. He himself showed judgment, prudence, and tact.

The whole action seems to have been not only necessary, but very promptly, quietly, and effectively executed.

The changes of the year in numbers are as follows:

GAIN.		LOSS.	
By recruits	333	By transfer	0
By transfer	5	By discharge	156
From desertion	35	By desertion	176
		By death	5

Of the above recruits 135 are only now on their way to their assigned stations, and it appears that 149 have been enlisted at the posts.

Conforming to instructions from division headquarters of January 19, 1872, since that date the discharged convicts of the department have been imprisoned at Forts Wayne and Niagara, and Madison Barracks. At Fort Wayne I find that, with this addition to ordinary prisoners, the prison accommodation is scarcely sufficient or secure; and if this plan be continued, the erection of a separate and stronger prison is recommended.

At Fort Niagara the difficulty has occurred of an insufficiency of force to guard securely the prisoners at work; this owing to the reduced strength of the single company constituting the garrison. If the change, which has been recommended, to a general prison-system be legalized, these difficulties of course will cease.

At Fort Brady the hospital is so old and worn that it is recommended that a small new one be erected next summer, in which case the old building would be used as long as habitable by laundresses, for whom there are now no quarters in the garrison grounds.

The health of the troops has been excellent; at my inspection of the posts there was scarcely the average of one patient in hospital.

I cannot on this occasion praise the proficiency in military exercises shown by some of the First Infantry garrisons, and particularly Fort Wayne, whose permanent commander has for several months been on detached duty.

The number of claims for honorable discharge, bounty, and pay, by late volunteers, mostly reported deserters on muster-out rolls of their organizations, received since last report, is 171, (in the preceding year 119;) the number disposed of during the year, 180; 87 receiving honorable and 93 dishonorable discharges, leaving 106 under investigation.

Very respectfully, your obedient servant,

P. ST. GEO. COOKE,
Brigadier-General, Commanding.

Colonel RICHARD C. DRUM,
*Assistant Adjutant-General, Military Division of the Atlantic,
Philadelphia, Pennsylvania.*

REPORT OF MAJOR-GENERAL SCHOFIELD.

HEADQUARTERS MILITARY DIVISION OF THE PACIFIC,
San Francisco, California, October 2, 1872.

SIR: I have the honor to submit the following report of operations in this military division during the past year.

The organization of the division remains the same as at the date of my last annual report. Generals Canby and Cook remain in command of the departments of the Columbia and Arizona, respectively. General Ord having been transferred on the 14th of December last to the Department of the Platte, the immediate command of the Department of California has, since that date, devolved upon the division commander.

The troops serving in the division are the same as during the previous year, with the exception of the Fifth Cavalry, from the Division of the Missouri, substituted for the Third, in the Department of Arizona.

The Twenty-first Infantry, having served the usual period in Arizona, has been transferred to the Department of the Columbia, being replaced by the Twenty-third from that department. One company of the Twelfth Infantry has been relieved from service in Arizona by another company of the same regiment from the Department of California. The remaining two companies of that regiment in Arizona will be relieved by similar transfers as soon as practicable. One of the batteries of the Second Artillery, composing the garrison of Sitka, Alaska, has, in like manner, been relieved by another battery from San Francisco. These transfers have been made from time to time during the year, as com-

panies could be moved without injury to the service, and with all possible regard to economy.

It is believed to be just and wise policy to limit the period of service of troops at very remote and unhealthy stations to a period varying from two to four years, according to circumstances.

The small force, (less than five hundred men,) exclusive of the garrisons in San Francisco Harbor, serving in the Department of California, has been successfully employed during the past year in preserving peaceable relations between the numerous bands of Indians inhabiting the mountainous regions of California and Nevada and the scattered settlers. Although the troops have frequently been called upon to prevent or settle minor difficulties between individuals, no serious disturbance of any kind has occurred. Many of the Indians are industrious, all are peaceably disposed, and continue to maintain very satisfactory relations with their white neighbors.

The only ground for serious apprehension in future is the starvation that is sometimes inevitable, during the severe winter months, unless relieved from the military stores. This humane and economical mode of preventing war by removing its cause having now been prohibited by law, unless the Indian bureau is fully prepared to meet such emergencies, which, I apprehend, it is not, a conflict with the Indians in this department during the coming winter may reasonably be expected.

Camp Independence, California, formerly built of adobes and destroyed by earthquake last spring, is now in process of reconstruction. The new buildings are to be of wood, obtained mainly in the vicinity of the post, put up in the plainest and most economical manner. The troops at the post (one company of the Twelfth Infantry) are doing an important service in protecting the settlement of Owen's River Valley and the adjacent mining regions. It is hoped that section will be able to dispense with the aid of troops in a few years.

Camp Halleck, Nevada, having been established before the location of the Central Pacific Railroad, is twelve miles from that road. It is consequently less efficient and more expensive in the supply of troops than it would be at some point on the road. Yet, as the buildings are now in good condition, having been repaired within the last year, to avoid the cost of building a new post, I do not now urge the removal of Camp Halleck. It is occupied by one company of the First Cavalry and one of the Twelfth Infantry.

Camp McDermit, Nevada, is barely fit for occupation during the coming winter by its present garrison—one company of the First Cavalry. It cannot be made comfortable for any considerable time at a cost less than that of the building of a new post. It is not well located, and is an expensive point for supplies. It is believed a much better point, nearer the railroad and nearer the sources of fuel and forage, can be selected. I therefore respectfully recommend that the necessary funds be supplied to rebuild Camp McDermit at a more suitable location.

Fort Hall, Idaho, recently transferred to this department from that of the Columbia, is a new post, well located, and in good condition, occupied by one company of the Twelfth Infantry.

Camp Bidwell, California, one company of the First Cavalry, is judiciously located in a rich section of country, where the presence of troops is very necessary to protect the large agricultural and grazing interests against Indian depredations. Even though the Indians be removed, as proposed, to a reservation at some distance, it will be necessary to maintain this post for effective protection of the settlements from raiding parties, which cannot be prevented from leaving the reservation. The

camp is in fair condition, but requires some repairs, for which special estimates will be made.

Camp Wright, one company, and Camp Gaston, two companies Twelfth Infantry, are judiciously located, and it cannot be foreseen when they will no longer be necessary. The buildings require some slight repairs, the estimates for which have been called for.

Camp Metah was a temporary summer camp located on the Lower Klamath River, for the purpose of preventing collision between two hostile bands of Indians, which threatened to involve the neighboring whites. The troops have recently been withdrawn to their quarters at Camp Gaston.

Angel Island and Benicia Barracks, California, are the headquarters of the Twelfth Infantry and First Cavalry, respectively, and are the depots from which recruits are distributed throughout the division, and the temporary quarters for troops *in transitu*. Additional barracks for one company of infantry should be built at Angel Island.

The Presidio of San Francisco is the headquarters and principal station of the Second Artillery. It is an important permanent post, to be occupied by the garrison troops of the neighboring defenses of the Golden Gate. Permanent barracks for this garrison are much needed, and I hope an appropriation will be made for their construction, according to the plans heretofore submitted.

Point San José, or Black Point, an important position in the defenses of San Francisco Harbor, is occupied by one battery of the Second Artillery, sheltered in temporary and inferior buildings. I do not recommend the construction of any permanent barracks until after the completion of the permanent fortification of the point.

Alcatraz Island, the most important interior position in the harbor of San Francisco, and now in process of permanent fortification, is also the military prison for the entire Division of the Pacific, and is much the most important post on the Pacific coast. It is garrisoned by two batteries of the Second Artillery, also serving as prison-guard. All soldiers convicted of desertion and other crimes, whose sentences involve dishonorable discharge from the service, are sent to this prison. The criminals are thus separated from contact with their former comrades, and the troops in active service are relieved from the burden of guarding them, while their escape is rendered impossible by the insular position of their prison. Their labor upon the fortifications more than repays all expense incurred on their account. This system is found to be in all respects advantageous to the service, and its general adoption is believed to be advisable.

Some enlargement of the prison at Alcatraz should be made, of which plans and estimates have heretofore been submitted, and permanent barracks for the garrison should be constructed within the next year. Plans and estimates for this building have been submitted by the board of engineers for the Pacific coast, with whose views on this subject I take pleasure in expressing my concurrence.

Yerba Buena Island, in addition to its great importance as a defensive position, is the best point for the main depot of supplies for the Pacific coast. It is now occupied by the division quartermaster's depot, under guard of a small detachment of the Second Artillery. The buildings are of a temporary character, but sufficient for present uses.

The business of the several staff departments of the Division and Department of California has been transacted during the year to my entire satisfaction, and with economy and fidelity to the Government.

I respectfully refer to the reports of Generals Canby and Crook for the details of operations in their departments.

I have the honor to be, very respectfully, your obedient servant,

J. M. SCHOFIELD,
Major-General, Commanding.

The ADJUTANT-GENERAL UNITED STATES ARMY, *Washington, D. C.*

REPORT OF BRIGADIER-GENERAL CANBY.

HEADQUARTERS DEPARTMENT OF THE COLUMBIA,

Portland, Oregon, October 1, 1872.

SIR: I have the honor to submit, for the information of the major general commanding, the following report of operations in this department during the past year:

Under instructions from division headquarters, the Twenty-third Infantry has been transferred to the Department of Arizona, and the headquarters and nine companies of the Twenty-first Infantry have joined from that department. Company H, Second Artillery, has joined from the Department of California, and Company I of the same regiment has been transferred to that department; and, by War Department General Orders No. 56, of June 26, 1872, the post of Fort Hall, Idaho, with its garrison, (Company C, Twelfth Infantry,) has been transferred to the Department of California. The force now in the department consists of four companies of cavalry, four of artillery, and nine of infantry, with an aggregate strength of (present and absent) 1,072, which will be increased by another company of the Twenty-first Infantry, now *en route* from the Department of Arizona.

The distribution will be as follows:

Fort Stevens, Oregon.—Company M, Second Artillery; aggregate present, 2 commissioned officers, 37 enlisted men.

Fort Klamath, Oregon.—Company B, First Cavalry, and Company F, Twenty-first Infantry; aggregate present, 4 commissioned officers, 99 enlisted men.

Camp Warner, Oregon.—Company F, First Cavalry, and Company D, Twenty-first Infantry; aggregate present, 3 commissioned officers, 94 enlisted men.

Camp Harney, Oregon.—Company H, First Cavalry, and Company A, Twenty-first Infantry; aggregate present, 4 commissioned officers, 89 enlisted men.

Fort Boise, Idaho Territory.—Company K, Twenty-first Infantry; aggregate present, 2 commissioned officers, 41 enlisted men.

Fort Lapwai, Idaho Territory.—Company E, First Cavalry, and Company G, Twenty-first Infantry; aggregate present, 5 commissioned officers, 91 enlisted men.

Fort Colville, Washington Territory.—Company E, Twenty-first Infantry; aggregate present, 2 commissioned officers, 47 enlisted men.

Fort Vancouver, Washington Territory.—Headquarters, and Companies C and I, Twenty-first Infantry; aggregate present, 14 commissioned officers, 197 enlisted men, and, after its arrival from Arizona, Company B, Twenty-first Infantry, aggregate unknown.

Fort Cape Disappointment, Washington Territory.—Company E, Second Artillery; aggregate present, 3 commissioned officers, 59 enlisted men.

Camp San Juan Island, Washington Territory.—Company H, Twenty-

first Infantry; aggregate present, 2 commissioned officers, 43 enlisted men.

Sitka, Alaska.—Companies C and H, Second Artillery; aggregate present, 6 commissioned officers, 115 enlisted men.

Vancouver Arsenal, Washington Territory.—Detachment of ordnance; aggregate present, 1 commissioned officer, 15 enlisted men.

The changes within the department are exhibited by the accompanying table A.

The changes in the *personnel* during the year have been as follows:

GAIN.		LOSS.	
By transfer.....	983	By transfer.....	1,033
By recruits.....	315	By discharge.....	218
From desertion.....	48	By death.....	9
		By desertion.....	239

One hundred and twenty-seven discharges were by expiration of enlistment, twenty-six for disability, fifty-five by sentence of courts-martial, and ten from miscellaneous causes. One hundred and six of the recruits were enlisted or re-enlisted within the Department. The proportion of desertion is as great as during the period embraced in my last report, and is due to the same causes. The laws of May 15, 1872, "to establish the pay of the enlisted men of the Army," and "to establish a system of deposit to prevent desertion, &c.," have been in operation too short a time to produce any marked effects, but it is not doubted they will soon work a very beneficial change.

The standard strength of the companies assigned to this department is 1,194, but the actual strength is usually so far below the standard that at small posts the effective strength is absorbed by the necessary working details, and when this occurs at posts in the Indian country and remote from succor, this condition is not only embarrassing, but is an exhibition of weakness that jeopardizes the influence of the post over the surrounding Indians. Several instances have occurred during the past year in which the ability to exhibit, and, if necessary, to apply force, would have exercised a salutary influence. The appropriate remedy is the concentration of the troops and the occupation of fewer points; but when this cannot be done, I recommend that the strength of artillery and infantry companies at remote and isolated posts, such as Fort Boise, Fort Colville, and Sitka, be increased to eighty men. Under existing laws, I suppose that can only be done by subtracting it from the strength of other companies more favorably located, and, objectionable as this might be, it is preferable to leaving distant posts in their present weak and inefficient condition.

The relations with the Indians in the department during the past year present no marked features. Some apprehension of trouble with the Modais made it necessary to keep a detachment in their country for a short time in the early spring. It is proposed by the superintendent for this State to collect these Indians during the present month, and establish them on their reservation near Yainax Station. No trouble is anticipated, but provision has been made for giving the superintendent the aid of the troops, if force should become necessary. Some robberies were committed in Southeastern Oregon by Pah-utahs of Wea-we-wa's band, but the robbers were promptly pursued by the troops, the property recovered, and the thieves are now undergoing punishment at Camp Warner. Some uneasiness was occasioned in Idaho by the annual assemblage of the Indians at their camas-grounds, following imme-

diately after some murders committed on Wood River by the band of "Bannack Suir," as reported on the 23d of July. The number assembled this year was about 2,500, and was composed mainly of Indians from the Nez Percé, Muatilla, and Snake Bannack reservations, and they were absent, it is understood, by permission from their respective agents. They are peaceable in their character, but are so liable to be misconstrued that, if their absence cannot be prevented, I think it would be good policy to send with the Indians from each reservation an agent or employé, who would be useful in controlling the Indians, and as a medium of communication between them and the settlers, in allaying any apprehensions that might be felt by them as to the objects and intentions of the Indians. If the cavalry force in the department is not reduced, I propose to send next year a company to Fort Boise during the season of camas-digging, and would have done so last summer but for the fact that the cavalry was then under orders to leave the department.

On the 1st of June a difficulty occurred at Sitka, in which some Indians living at Cross Sound were wounded. The band to which the Indians belonged assumed a threatening attitude upon the occasion of the visit of the steamer *Rose*, a trading-vessel, to that place. No actual hostility was committed; but as the trade in Alaska is extended, it is very possible that outrages may be committed, and as our future relations with these Indians will very greatly depend upon our ability to meet and punish them promptly, I renew my previous recommendation that an armed steam-vessel should be stationed at Sitka. For the same reason, the strength of the garrison should be increased, as suggested above, as with the present strength no detachments can safely be made. Some confusion seems to exist with regard to the sale of arms and ammunition to the Indians in Alaska. The instructions of February 20, 1869, have been suspended by others of a late date, the exact purport of which is not known here. The collector at Sitka complains of the commanding officer for not breaking up the liquor traffic, while, on the other hand, it is represented that the efforts of the military authorities are embarrassed by the fact that liquors seized by the custom-house are sold at Sitka, the vendors alleging that they sell only what they have purchased from the Government, and that the purchase carries with it the right to sell. To take away this excuse, it is recommended that the Secretary of the Treasury be asked to direct that liquors seized hereafter be sent out of the district for sale.

Since the date of my last report, a reservation has been selected for the Pah-Utah Indians in Southeastern Oregon, and another in Washington Territory for the Indians north of the Columbia and Snake Rivers and east of the Cascade Mountains. The concentration of the Indians upon these reservations will authorize a reduction in the number of posts and a corresponding increase in the efficiency and economy of the service. The explorations in Southeastern Oregon show that Camp Harney is eligibly situated for the control of the Indians on the new reservation, and a copy of Major Otis's report is transmitted herewith, marked B.

The explorations north of Snake River, interrupted by the proposed transfer of cavalry from this department, were resumed as soon as it was known that the transfer would not be made, and have just been concluded. As soon as Captain Sanford's detailed report is received, it will be forwarded, with a separate report.

In the neighborhood of the proposed reservation in Western Idaho and Washington Territory there are a number of Indians who have established themselves outside of the limits of the proposed reservations,

and made improvements that are of value. They are generally of the mixed race, and, although still retaining the tribal connection, have but little tribal interest; and it would be a serious hardship if they were compelled to abandon their homes and go upon the reservations. It is hoped that some arrangement can be made by which their homes can be secured to them and made inalienable for a number of years. The sooner the tribal organization is broken up and the Indians absorbed into the general community, the better it will be for them and for us; and I think that this case presents a fair opportunity for making the experiment.

The posts in the department have all been inspected since the date of the last annual report, and found to be improving in discipline and in administration. The health and comfort of the troops have been well cared for, and the sanitary condition has been excellent. The medical director reports 1,422 cases of disease and 8 deaths during the year.

The condition of the works and public buildings at some of the posts is very poor. The fortifications at the mouth of the Columbia, (Fort Stevens and Fort Cape Disappointment,) constructed hastily and of indifferent material, are rapidly falling into decay, as will be seen by the accompanying reports, marked C, D, and E. While there is no anticipation of their being soon needed for the defense of the river, the importance of the positions they occupy, and the growing importance of the country they are intended to cover, require that they should not be left in their present unserviceable condition. At Fort Klamath a new hospital, officers' quarters, (already authorized, but the work postponed,) and very extensive repairs and improvements are needed. The buildings at the post are of the most flimsy and temporary character, and it will cost almost as much to put them in proper condition as to erect new buildings. For this reason, and because the present location of the post is almost inaccessible during several months of the year, I have delayed submitting estimates until I can learn the result of a reconnaissance now being made. (See reports herewith, marked F.) I have already recommended that Camp Warner should be abandoned and its garrison transferred to Camp Harney. As this post has now accommodations for three companies, with capacious store-houses and stables, it will be necessary to make provision for one company only, and estimates for this are now being prepared.

At Fort Lapwai a new hospital and new officers' quarters will be required if the post is continued. The Indian commissioners have recommended its abandonment and the establishment of a new post to the north, and the explorations made indicate two or three points where a post could be established that would subserve the purposes of both Lapwai and Colville, and cover the whole of that frontier much more effectually. At Fort Colville the repairs needed will cost more than the buildings are worth. (See report, marked G.) Fort Dalles has been used for several years past only as a sub-depot for interior posts, but is now no longer needed for that purpose, and I recommend that it be abandoned as a military post and sold. The report of the assistant inspector-general, showing the present condition and estimated value of the buildings, is transmitted herewith, marked H.

Estimates for the repairs required at Fort Townshend to prepare it for re-occupation, when the troops are withdrawn from San Juan Island, have already been submitted.

Proposals for the purchase of the buildings at Forts Kenoi and Kodiak, Alaska, have been made, but were rejected because the price offered was too small, and because the title to some of the buildings at Kodiak—

those transferred by the Russian authorities—is understood to be in contest.

It was hoped that the decision upon the Mission claim to a part of the reservation at Fort Vancouver would have settled all the questions, but since the decision was announced two other claims have been revived, and are now being pressed.

For details of operations in the several staff departments, reference is made to the reports, transmitted herewith, marked I, K, L, M, and N.

Very respectfully, your obedient servant,

ED. R. S. CANBY,

Brigadier-General, Commanding Department.

The ASSISTANT-ADJUTANT-GENERAL

Military Division of the Pacific, San Francisco, California.

REPORT OF COLONEL CROOK.

HEADQUARTERS MILITARY DIVISION OF THE PACIFIC,
San Francisco, California, October 18, 1872.

SIR: I have the honor to forward herewith the annual report of Brevet Major-General George Crook, commanding the Department of Arizona, to accompany my report of October 2, 1872.

I think it must now be evident that forbearance toward the Apaches of Arizona has reached its extreme limit, and that no course is left us but a vigorous and unremitting prosecution of the war they have so long invited, until they are completely subdued. I recommend that General Crook be given ample means and full authority to deal with this difficult problem. While the generous provisions made for those Indians who remain upon their reservations should be continued as long as necessary, great care should be taken not to afford, in this manner, a place of refuge and of preparation for those engaged in acts of hostility. The department commander should have full authority to prevent such abuse and, for this purpose, to impose all necessary restrictions upon the Indians on reservations.

The importance of telegraphic communication with the principal points in Arizona is so great that I unite with General Crook in again inviting attention to this subject, and beg leave to refer to my special report of December 12, 1871, for the details of the proposed line and estimated cost of construction.

Very respectfully, your obedient servant,

J. M. SCHOFIELD,

Major-General, Commanding.

The ADJUTANT-GENERAL UNITED STATES ARMY,

Washington, D. C.

HEADQUARTERS DEPARTMENT OF ARIZONA,
Prescott, September 21, 1872.

SIR: Referring to affairs in this department since my annual report of last year, I have the honor to state that at the time that report was made headquarters of the department were *en route* to this place, at which point they were ordered to be re-established, in pursuance of authority from the division commander.

The officers composing the department staff, with their clerks and records, arrived here October 2, a month later than I had anticipated, and where I had been waiting since September 1.

Temporary shelters for the officers, offices, and records were hastily erected, and hostilities against the Indians having been suspended, attention was directed to correcting the many abuses which were in existence in the administration of affairs in the department, and which the distance from headquarters, at which the posts were located, had heretofore rendered it difficult, if not impossible, to remedy.

The records were full of applications from officers serving outside of the department, or from chiefs of departments at Washington, for information and data to close this or that account. To facilitate this, boards of survey were instituted, inspections by competent officers ordered, and a general closing up of unsettled business inaugurated, and the past year has been one in which the administrative departments have been put in admirable working order; and with the improvements still going on in this direction, under the efficient chiefs of the respective departments on duty at these headquarters, it is hoped that in the future Arizona, instead of being a place where all the irregularities known to the service exist, will present as fair a record for economical and effective administration as can be found elsewhere in the Army.

The quartermaster's department has had to labor not only against the natural climatic disadvantages, which make transportation of great difficulty, but the movements of the Third Cavalry and Twenty-first Infantry out, and the Fifth Cavalry and Twenty-third Infantry into the department, imposed additional burdens in that direction, which it was impossible to foresee, or, with the limited quantity in the department, to provide for. In consequence, contractors for transportation of supplies have in some instances failed, or moved so slowly as to render it almost as embarrassing as complete failure.

The transportation of supplies in a country where ox and mule teams are the sole dependence is, of course, necessarily slow, but in this country, where there is such a dearth of grass and water, most of the roads passing over arid deserts, upon which the rays of a burning sun fall with uninterrupted fierceness for months, the problem is proportionately complicated.

Not only this, but the freighter encamped for the night is liable to find himself the next morning without animals to haul his heavily-loaded wagons, while the Apaches are feasting upon his mules or oxen.

Upon investigation it was found that the number of draught-animals in the department was largely in excess of the allowance prescribed in existing orders, and measures were taken to have the surplus, consisting of broken-down and worthless animals, condemned and sold at public sale.

While the number of animals for draught purposes was thus materially reduced, the efficiency of the transportation belonging to the Government was not impaired, and the worthless animals sold made a great saving of expensive forage.

While depending upon the somewhat uncertain transportation afforded by the country is often the source of vexatious delays and expense to the Government, it is thought that for the Government to maintain its own transportation would be a heavier expense, and certainly a great outlay in the beginning, and it would therefore be better to trust to the improvements that time will undoubtedly bring in this particular, and continue to contract for the transportation of supplies, using such measures as may be in the power of the Government to enforce compliance

with contracts entered into by parties controlling the means of transportation in the country.

In the furnishing of the forage-supplies required in the department, the quartermaster's department has been embarrassed by failures on the part of contractors, and although the remedy provided may in part recompense the Government in future, the evil, for the time being, is accomplished; *e. g.*, suppose a contractor agrees to furnish a hundred thousand pounds of barley, at a certain point, on a certain day, and places himself under bonds to do so. The horses and mules at the point specified are made the sufferers if the contractor fails, as it does not help them, or the expedition or duty depending upon them, that the contractor pays for his failure in future. It is, therefore, important that contractors, for this important supply especially, should be not only under good and sufficient bonds, but, in cases of repeated failure, contracts should not be intrusted to them.

Ever since the occupation by our troops of Arizona, the public quarters occupied by the troops have been, generally speaking, unfit for the occupation of animals, much (more) less the troops of a civilized nation. This condition is probably traceable to several causes, among which may be mentioned a want of judicious use of the funds set apart for this purpose, a lack of interest and energy on the part of the officers themselves, who, being heretofore so far from department headquarters, and apparently farther still from any one having any interest in their comfort or welfare, have undoubtedly felt themselves rather in a position to endure their tour here as a punishment than to exert themselves to make their posts habitable.

Although the fund for this purpose is small, by a judicious use of it, and a careful consolidation of small into large posts, there has been a vast improvement in this respect, and when the two posts under orders for establishment in the southern part of the Territory, one near Tucson and one on the Arivapai, near Grant, to take the place of four now occupied, the troops in the department will be as comfortable as temporary barracks can make them.

For details in relation to affairs in the quartermaster's department your attention is respectfully invited to the inclosed copy of Major Dana's report, (A,) in whose hands its complicated and difficult duties have been energetically and faithfully administered.

SUBSISTENCE DEPARTMENT.

In a country where communications are so uncertain as this, it has always seemed to me that the officer who controlled the subsistence supplies for the department should be near department headquarters, for obvious reasons, one only of which I mention: the changes in the number of troops drawing supplies from a post, which are liable to occur at any time where active operations are either in progress, or are at the best but temporarily suspended, which it would be impossible to foresee, and which, to properly provide for, the officer controlling should be near the department commander.

Upon my recommendation, concurred in by the division commander, authority was given by the War Department to retain the services of Major Evans, Third Cavalry, in this capacity. This officer assumed his duties early in December.

Nearly all the subsistence supplies for this department are furnished under the direction of the chief commissary of the division at San Francisco, the chief commissary of this department having no control over

them until they arrive at Yuma depot, Arizona City, at which point an officer under his direction has had special charge of the duties since March.

As far as could be anticipated, the depot commissary at Yuma has been advised of changes in strength of garrisons, and the destination of stores changed in accordance therewith; but there has been some delay in getting the supplies forward to some of the posts, subjecting officers and men to inconvenience, to avoid which a few purchases in open market at high rates have been made. This failure may be attributed to the non-arrival at Yuma of the stores purchased for Indians, thereby causing the supplies for the troops to be diverted from their proper use; to the unexpected demands made upon the transportation in the country by the movements of the troops before mentioned, and the consequent failure on the part of contractors engaged in transporting these supplies from the Colorado to the posts in the interior.

The want of proper store-houses at the different posts has, heretofore, been the cause of serious losses by exposure to climatic influences and theft. Many of the store-houses have heretofore been occupied as offices, and, through constant passing and repassing of persons having or pretending to have business there, both large and small stores were purloined, these thefts being covered in one way and another.

The store-house at Camp Hualpai was found to have been prepared for conflagration by a train of combustibles carefully laid, and ready for lighting, undoubtedly the work of some previous occupants; and the store-house at Camp Date Creek was destroyed by fire, the cause of which was its occupation by the enlisted men employed in the office, whether by accident or design I am unable to say.

In addition to this, issues were too generally made under the supervision of non-commissioned officers, or other irresponsible parties, subjecting the Government to frequent loss, with no means of establishing the responsibility. To remedy this, General Orders No. 5, (inclosure B) was issued, providing for secure store-rooms and cellars, store-rooms to be without fires, to be unoccupied by clerks and enlisted men, constantly under sentry, and never opened except in the presence of an officer, preferably the officer responsible for the stores, by whom all issues were to be superintended in person.

The store-rooms either have been or are being provided as rapidly as possible, and the regulations prescribed carried out, to great advantage to the service and saving to the Government.

It will be observed that Major Evans has been in charge of these duties for only about eight months, but in that time he has inaugurated reforms long needed, and, so far as he has had control of the affairs of his department, has exercised that control for the best interests of the public service, and to my entire satisfaction. His able and interesting report is appended, marked C, to which your attention is respectfully invited.

MEDICAL DEPARTMENT.

With the improvements in quarters, and the personal attention of an officer of high rank and experience in this department, present at department headquarters, the care of the sick is daily improving. Good results have attended the recommendation of the medical director for the changing of stations of enlisted men suffering from local malaria, as well as chronic cases, to the hospital at this station, where they could be treated under his immediate supervision. In some instances men supposed to be incurable, and subjects for discharge, have been saved

to the service. His recommendations relative to bathing facilities for enlisted men are excellent, and it is hoped that as the posts are improved, this feature, so important to the health of the troops, will receive the attention it deserves.

Efforts have repeatedly been made to secure to this department a proper share of the young medical officers of the Army, without success. While I should not recommend that any officer of the staff corps be kept at the objectionable posts in the department for over two years, yet a due regard for the care of the troops serving at these distant stations demands that they should have the best of medical attendance, instead of, as is too often the case, the most worthless of the class employed by the Department. While there are so many that are worthless, due care should be taken not to confound those of known worth in the same list. There are notable instances of excellent men in the department, who are employed by contract, and the recommendation of the medical director in regard to a system of changes of station, to apply to them as well as to other officers, is concurred in.

Surgeon E. I. Bailey has been the medical director of the department during the year, and has from time to time urged the recommendations herein mentioned relative to the officers of his corps, and which I trust will receive that attention in the future which has been denied them in the past. His valuable report is appended, marked D, to which you are respectfully referred for important details.

PAY DEPARTMENT.

Heretofore payments of the troops serving in this department have been made by paymasters assigned to duty in Arizona, but stationed in San Francisco. For this purpose a large number of animals, spring and Army wagons were kept constantly employed in transporting each paymaster, as he arrived at Yuma, from that point through the department. This system was attended with such heavy drains upon the quartermaster's department for animals, wagons, and forage, and upon the troops for escorts, as to render it very desirable that some other method be adopted, and a change is now being made, by which there is to be a paymaster each at Tucson and Prescott, from which points payments can be made regularly, and with a great saving to the Government compared with the former method.

The stationing of a paymaster at Prescott is an additional reason to be urged for the establishment of a designated depository at that point, which I have frequently urged upon the attention of the proper officers, and which I believe is now receiving the attention of the honorable Secretary of War and the Paymaster-General.

Major C. J. Sprague is the chief paymaster of the department, but, with the other officers of his department, has heretofore been stationed in San Francisco, under the immediate orders of the division commander, and from whom no report has been received. I believe, however, the troops have been as regularly paid as the system would allow.

INSPECTIONS OF PUBLIC PROPERTY.

In consequence of the large amount of public property being condemned and disposed of, under that paragraph of the Regulations (1019) which allows commanding officers to inspect, without, as I believe, due regard to economy and the interests of the public service, I felt that the system needed a check, and issued General Orders No. 20, series of

1871, (copy inclosed, marked E,) forbidding such inspections, except by regularly or specially appointed inspectors, diseased horses and perishable stores, rapidly deteriorating, only excepted. This, of course, imposed additional burdens upon the division inspector, and rendered necessary the appointment of a department inspector, for which the authority of the War Department was asked and obtained. Captain W. H. Brown, Fifth Cavalry, was appointed department inspector, and has recently entered upon his duties, which bid fair to be numerous and important to the service.

TELEGRAPHIC COMMUNICATION.

The nearest telegraphic communication to be had is with the office at Los Angeles, California, which is generally reached from here by mail in seven days.

There can be no doubt that the establishment of telegraphic communication with all the important points in the Territory with the connecting lines outside, would be an advantage to the public service too great to be estimated. The particular points from which and to which the lines should run are questions easily determined by proper officers, but the general fact that the establishment of such communication is a public necessity is too patent to need argument, and only requires that I should invite that earnest attention thereto which the importance of the subject demands.

BOARDS OF SURVEY.

The defects which have existed in the system of boards of survey, as heretofore practiced, and which have been pronounced by officers of high rank as "mere whitewashing concerns," have been overcome in a great measure, by a system, a brief of which is embodied in Circular No. 6, of 1871, (appended and marked F,) from these headquarters, which, among other important changes, requires the proceedings to be approved by the department commander, previous to being used as sub-vouchers to accounts. Heretofore the proceedings were considered complete upon the approval of the officer commanding the post, and were too often received back from the accounting officers at Washington, for correction, many months, and sometimes years afterward, when the officer concerned had been called to duty elsewhere, and the necessary data long since disappeared.

Under the present practice at these headquarters, as soon as the proceedings of a board of survey are received they are submitted to the chief of the department on duty here, in whose department the property or stores belong, who carefully reviews and returns them to the adjutant-general with his remarks. The remarks, being on separate slips of paper, are retained in the adjutant-general's office until the proceedings have been submitted to another officer of the staff, whose review is of a more general character. The proceedings, with the remarks of both officers, are then carefully examined and revised by the adjutant-general of the department, who submits the whole to the department commander for his orders.

If there are any defects they are carefully pointed out in the indorsement, returning them for correction, and when complete and approved, one copy, with all the remarks, is retained at these headquarters for file and future reference, the others being disposed of as directed in existing regulations.

By this method the proper staff officers at department headquarters are always advised of damages that may have occurred to property in their departments, and the probable cause for the same, while the proceedings themselves are rendered complete, correct, and a valuable means for establishing administrative responsibility.

TROOPS.

The present organization of troops serving in this department, with the aid of our Indian allies, will, I think, be sufficient, but the organizations themselves should be filled up to the maximum allowed by law. As they are now, their strength is, in most cases, below even the minimum, which, reduced as they are by sick and absentees, makes the effective force for actual service a very small one. I would, therefore, earnestly recommend that the requisitions for recruits for these organizations be filled, and the men forwarded to their commands at the very earliest possible date. (See inclosure marked G.)

ESCORTS AND GUARDS.

In connection with the remarks relative to filling the organizations to their maximum, I would mention that I am constantly called upon to furnish escorts to surveying parties and Government officials, as well as citizens passing from one post to another, and guards for families living in isolated localities threatened by Indians, which, in most cases, I would be powerless to grant, even if the number of troops at my command were four times as great; still, with the greatest economy in this particular, I am often obliged to comply, and the drain is very great. When troops are to be used as escorts, I have generally required them to travel in open wagons adapted to the purpose, in order to save the horses of the mounted troops for actual service. This method of transporting escorts has been found to be a great saving of public animals, and materially aids in keeping the cavalry arm ready for service.

Attention is invited to the inclosed order on this subject, General Orders, No. 16, series of 1871, as well as General Order, No. 23, current series, relative to furnishing forage to public animals *en route*, both of which are appended and marked H and I.

INDIANS.

Although authority from various sources has been given for the chastisement of hostile Indians, in order to co-operate effectively with the different agents sent to make peace with them, the operations having in view such chastisement have necessarily been confined to pursuit and punishment of parties actually engaged in massacres of citizens or depredating upon their stock. Such pursuit is too generally unsuccessful, for the reason that when out on these raids the Indians are necessarily on the *qui vive*, and where such is the case in a country cut up by huge cañons, with miles of lava-beds, over which an Indian can pass without leaving the slightest mark by which he may be trailed, finding him, much less his surprise or capture, is next to impossible, and the merest accident in the world.

Add to this fact that Indians on some of the reserves, ostensibly at peace, and feeding upon Government stores, have been accomplices, and, in some cases, principals in robberies and murders, of which the innocent of the same tribes, owing to fear and other causes, will not inform, and some of the difficulties can be understood.

Having in view the great and earnest desire of the Government to find a peaceable solution of this problem, I have earnestly and honestly supported the agents sent out for this work, and the long and bloody list of murders and robberies committed during the year, by the very Indians who, at one time or another, have been fed at the public expense, is a ghastly commentary upon the result.

I append herewith a list of these outrages (marked K) which does not, by any means, comprise all, but such as I officially vouch for.

I think, therefore, I am justified in saying that I have fully carried out that portion of my instructions which required me to co-operate with the agents referred to, and believe that humanity demands that I should now proceed to carry out the remainder of my instructions, which require me to punish the incorrigibly hostile. In doing this I shall ask and expect from the civil agents of the Indian Department that hearty co-operation in the future which I have not failed to extend to them in the past.

CONCLUSION.

The officers of my staff, not named in the foregoing report, are, Captain A. H. Nickerson, Twenty-third Infantry, aide-de-camp and acting assistant adjutant-general of the department; Second Lieutenant William J. Ross, Twenty-first Infantry, aide-de-camp and field quartermaster; Second Lieutenant John G. Bourke, aide-de-camp, field adjutant.

I am, sir, very respectfully, your obedient servant,

GEORGE CROOK,

*Lieutenant-Colonel Twenty-third Infantry,
Brevet Major-General, Commanding Department.*

The ASSISTANT ADJUTANT-GENERAL

Military Division of the Pacific, San Francisco, California.

Depredations committed by Indians in the Department of Arizona.

September 1, 1871.—Eight head of horses, belonging to miners, stolen from Pine Flat.

September 4, 1871.—Post herd of Camp Crittenden, consisting of fifty-seven horses and eight mules, driven off.

September 5, 1871.—Gabriel, a Mexican herder, in the employ of Mr. Campbell, murdered in Chino Valley.

September 10, 1871.—A party of Pinal prospectors fired into; one man and two horses killed.

September 13, 1871.—Mail-rider and stock-herder murdered two miles from Tucson; mail captured and destroyed.

September 22, 1871.—House of Daniel Hatz, at Agua Fria, burned, and several head of stock stolen.

October 14, 1871.—Ranch of R. M. Gilbert, on Cienega Sauz, burned; Richard Barnes killed and Mr. Gilbert wounded.

November 5, 1871.—Mail-stage on route from Wickenburgh to Ehrenberg attacked about nine miles from the former-named place. Driver, John Lauz, and passengers Frederick Shoholen, Frederick W. Loring, E. M. Hamel, W. G. Salmon, and C. S. Adams, killed, and Frederick Kruger and Miss Shepard wounded.

January 4, 1872.—One hundred head of stock, belonging to citizens near Camp Hualpai, stolen and driven off.

January 13, 1872.—Cattle-herd at Camp Bowie stampeded.

January 20, 1872.—Mail-stage, on route from Tucson to Camp Bowie, attacked; Thomas Donovan, A. J. Bice, and John Petty, killed; driver, John Bedford, wounded.

January 24, 1872.—A party of citizens, engaged in cutting hay near Camp McDowell, fired upon.

January 26, 1872.—Stock stolen near Fort Rock, on Prescott and Mojave road.

February 8, 1872.—Five head of oxen, belonging to citizens, stolen near Camp McDowell.

February 17, 1872.—Auguerre's freight-train attacked on the Hassayampa, and two men wounded.

February 20, 1872.—Robert Bell badly wounded near Camp Verde.

February 21, 1872.—Mr. Leroux shot at and dangerously wounded near Camp Verde.

February 22, 1872.—Cullumber's Station, near Date Creek, attacked; S. T. Cullember and Thomas Harris killed, and stock stolen.

February 26, 1872.—Cattle-herd at Camp Bowie driven off; one herder killed and one wounded.

March 17, 1872.—Eight head of work-oxen stolen from citizens near Camp Verde.

March 17, 1872.—Endilleso Rebas murdered near Camp Verde.

March 24, 1872.—Mr. Rivas killed near Camp Verde.

March 29, 1872.—Mr. Gallaher wounded near Camp Verde.

April 17, 1872.—Osborn P. Clack killed about one mile north of Mint Valley.

April 19, 1872.—James Kelliher wounded, and three head of stock stolen in Verde Valley.

April 20, 1872.—J. Callaghan wounded by Indians on Beaver Creek.

April 20, 1872.—George W. Smith and Joseph Ackerman killed near Wornuser and Wertheimer's ranch, on the Agua Fria; four horses stolen.

April 17, 1872.—Private William Irwin, Company D, Twenty-first Infantry, killed while on escort duty to Camp Apache.

April 20, 1872.—Twenty head of beef-cattle stolen at Tubac, Pima County.

April 26, 1872.—A Mexican killed near Camp Crittenden, and eight head of stock stolen.

April 27, 1872.—House of John Whitehead, in Sonoita Valley, attacked; Mr. Whitehead and one herder killed; Mrs. Whitehead wounded.

May 4, 1872.—Two horses and one mule stolen, and cattle-herd fired into and stampeded near Camp Verde.

May 4, 1872.—Mail-stage between Tucson and Camp Bowie attacked; driver, Henry Abrahams, killed, and mail captured.

May 4, 1872.—Stock stolen from Mr. Brewster, near Camp Hualpai.

May 10, 1872.—Three men killed on farm of Wales Arnold, near Camp Verde.

May 11, 1872.—Stock stolen from the mail-station, four miles from Camp Date Creek.

May 15, 1872.—Beef stolen from beef-contractor at Camp McDowell.

May 18, 1872.—Stock stolen from Mr. Brewster, near Camp Hualpai.

May 20, 1872.—Cattle-herd of beef-contractor at Camp Verde run off.

May 22, 1872.—Florence Cosgrove killed, and two horses stolen in Sonoita Valley.

May 22, 1872.—Theodore Putz killed near Prescott, and 2,000 head of sheep stolen; stock afterward recovered.

June 7, 1872.—Stock stolen from Thomas Hughes, and one herder killed in Sonoita Valley.

June 13, 1872.—Adam Riesbeck mortally wounded near Prescott.

June 15, 1872.—Joseph Goldwater badly, and Dr. Jones slightly wounded, while crossing Granite Mountain.

June 15, 1872.—Sheep-herd of Mr. Stevens stampeded near Prescott, and herder wounded.

June 20, 1872.—Three hundred head of cattle, belonging to Campbell & Baker, stolen near Oaks and Willows.

June 24, 1872.—Moore & Gardner's ranch, in Sonoita Valley, attacked; Adolphus Brown killed, and six horses and four guns stolen.

July 5, 1872.—Twenty mules stolen from Mr. Jacob's train, three miles from Camp McDowell.

July 26, 1872.—Two horses and one mule stolen from Indian agency at Camp Grant.

July 31, 1872.—Stock stolen from Mr. Reavis, near Camp McDowell.

August 27, 1872.—Second Lieutenant Reid T. Stewart, Fifth Cavalry, Corporal Joseph Black, Company F, Fifth Cavalry, and two Mexicans, murdered in Davidson's Cañon.

August 27, 1872.—Four Mexicans murdered on Santa Cruz River.

September 4, 1872.—W. V. Goodrich murdered eight miles below Camp Mojave.

September 4, 1872.—All stage and other stock stolen from Cullen's Station, on the Wickenburgh and La Paz road.

RECAPITULATION.

Officers: killed, 1. Enlisted men: killed, 2. Citizens: killed, 41; wounded, 16. Cattle stolen: property of Government, 68; property of citizens, 489.

There were also several head of cattle stolen from citizens, September 22, 1871, January 26, February 22, May 4, 11, 13, and 20, June 7, July 31, and September 4, 1872, but the number is not stated.

The records at headquarters Military Division of the Pacific show that the cattle reported as having been "stampeded" at Camp Bowie, January 13 and February 26, 1872, and at Camp Verde, May 4, 1872, were recovered.

HEADQUARTERS MILITARY DIVISION PACIFIC,
San Francisco, October 16, 1872.

REPORT OF BRIGADIER-GENERAL TERRY.

HEADQUARTERS DEPARTMENT OF THE SOUTH,
Louisville, Kentucky, October 1, 1872.

SIR: I have the honor to submit the following report of military operations in this department since October 26, 1871, the date of my last annual report:

At that date the Department of the South comprised the following States, viz, South Carolina, Georgia, Florida, Alabama, Mississippi, Tennessee, and Kentucky, and formed part of the Military Division of the South, commanded by the late Major-General H. W. Halleck. January 15, 1872, the Division of the South was discontinued, and I was directed to report direct to the Adjutant-General of the Army.

The troops occupying the various posts in the department consisted of the Seventh Cavalry, eleven batteries of the Third Artillery, and the Second, Fourth, Sixteenth, and Eighteenth Regiments of Infantry.

The posts were garrisoned as follows:

SOUTH CAROLINA.

Charleston.—Light Battery C and Battery I, Third Artillery. (Temporarily at Summerville, South Carolina.)

Columbia.—Companies B, D, and I, Eighteenth Infantry, and L and M, Seventh Cavalry. (L detached service, Winnsborough, and M, Darlington, South Carolina.)

Chester.—Companies C, Seventh Cavalry, and H, Eighteenth Infantry. (Company C, Seventh Cavalry, temporarily at Rutherfordton, North Carolina, in the Department of the East.)

Yorkville.—Companies K, Seventh Cavalry, and C, Eighteenth Infantry.

Newberry.—Company K, Eighteenth Infantry.

Unionville.—Company B, Seventh Cavalry.

Spartanburgh.—Companies E, Seventh Cavalry, and D, Second Infantry.

Sumter.—Company F, Eighteenth Infantry.

GEORGIA.

Fort Pulaski.—Batteries E and H, Third Artillery.

Savannah.—Battery K, Third Artillery.

Atlanta.—Companies G, Seventh Cavalry, A and C, Second Infantry, and A, E, and G, Eighteenth Infantry.

FLORIDA.

Saint Augustine.—Companies F and H, Second Infantry, and K, Sixteenth Infantry.

Key West.—Batteries B and D, Third Artillery.

Fort Jefferson.—Batteries F, L, and M, Third Artillery.

Fort Barrancas.—Battery G, Third Artillery.

ALABAMA.

Huntsville.—Company B, Second Infantry.

Mobile.—Companies G and K, Second Infantry.

MISSISSIPPI.

Jackson.—Companies B and H, Sixteenth Infantry.

Meridian.—Company I, Sixteenth Infantry.

Aberdeen.—Company C, Sixteenth Infantry.

TENNESSEE.

Nashville.—Companies H, Seventh Cavalry, and F and G, Sixteenth Infantry.

Humboldt.—Company D, Sixteenth Infantry.

Chattanooga.—Companies E and I, Second Infantry.

KENTUCKY.

Taylor Barracks.—Louisville, Company F, Seventh Cavalry, H, Fourth, and A and E, Sixteenth Infantry. (F, Seventh Cavalry, detached service at Meridian, Mississippi.)

Frankfort.—Companies G and K, Fourth Infantry.

Lexington.—Company A, Fourth Infantry.

Crab Orchard.—Companies D, Seventh Cavalry, and B, Fourth Infantry. (Company D, Seventh Cavalry, temporarily at Columbia, South Carolina.)

Paducah.—Company D, Fourth Infantry.

Mount Sterling.—Company E, Fourth Infantry.

Elizabethtown.—Companies A, Seventh Cavalry, and F, Fourth Infantry.

Lebanon.—Companies C and I, Fourth Infantry. (Company C, detached service, Lancaster.)

Shelbyville.—Company I, Seventh Cavalry.

Newport Barracks.—Recruiting depot.

The principal changes which have taken place in the distribution of troops in this department during the past year are as follows:

On October 26, 1871, Battery I, Third Artillery, was ordered from Charleston to Spartanburgh, South Carolina.

On October 31 Company M, Seventh Cavalry, ordered from Spartanburgh to Unionville, South Carolina, and Company B from Unionville to Spartanburgh, South Carolina.

November 1. By General Order No. 66, War Department, Adjutant General's Office, series of 1871, the State of North Carolina was transferred from the Department of the East to this department, thus adding seven batteries of the Fourth Artillery to my command. They were stationed at the time of transfer in the following manner, and so continue at the present time:

Charlotte.—Battery A, Fourth Artillery.

Rutherfordton.—Battery C, Fourth Artillery.

Raleigh.—Batteries D and H, Fourth Artillery.

Fort Johnston.—Battery G, Fourth Artillery.

Fort Macon.—Batteries K and L, Fourth Artillery.

By the provisions of the same general order the State of Mississippi and the Gulf posts as far eastward as, and embracing, Fort Jefferson and Key West, were transferred from my command to form part of the newly-created Department of the Gulf. Subsequently, by General Order No. 71, from the War Department series 1871, the post of Mobile, Alabama, was exempted from the provisions of General Order No. 66, from the same source.

The six batteries of the Third Artillery, which formed the garrison of Key West and Forts Jefferson and Barrancas, Florida, and four companies of the Sixteenth Infantry, which were stationed at Jackson, Aberdeen, and Meridian, Mississippi, were thus transferred from my command.

November 14 Company F, Seventh Cavalry, was ordered to return to its proper station in this city from detached service at Meridian, Mississippi.

Company I, Eighteenth Infantry, was ordered from Columbia to Unionville, South Carolina, and Company G, Eighteenth Infantry, from Atlanta, Georgia, to Columbia, South Carolina.

All traces of yellow fever at Charleston, South Carolina, having disappeared, the garrison of that post, which had been temporarily at Summerville, South Carolina, was, on November 14, ordered to return to Charleston.

On November 24, Companies E, Eighteenth, and C, Second Infantry, at Atlanta, Georgia, and one section of Light Battery C, Third Artillery, at Charleston, were ordered to Columbia, South Carolina.

On December 11 Company E, Seventh Cavalry, was ordered from Spartanburgh to Unionville, South Carolina.

On December 27 Company H, Seventh Cavalry, was ordered from Nashville, Tennessee, to Huntsville, Alabama.

On December 30 Company I, Eighteenth Infantry, was ordered back to Columbia from Unionville, South Carolina.

January 10, 1872, the section of battery temporarily at Columbia was ordered to return to Charleston, South Carolina.

On January 13 the remains of the late Major-General H. W. Halleck were temporarily deposited in one of the vaults of Cave Hill Cemetery, in this city.

Companies F and G, Sixteenth Infantry, from Nashville, Tennessee; Companies I, Fourth Infantry, from Lebanon, G and K, from Frankfort, and F, Fourth, from Elizabethtown, Kentucky, arrived in Louisville, and with the three companies of infantry and one of cavalry stationed in this city formed the funeral escort. The troops afterward returned to their proper stations.

January 14 Company B, Eighteenth Infantry, was ordered from Yorkville to Columbia, South Carolina.

January 16 Company C, Second Infantry, was ordered to Huntsville, Alabama, from Columbia, South Carolina, and Company B, of the same regiment, ordered from Huntsville, Alabama, to Atlanta, Georgia.

January 23 Company E, Eighteenth Infantry, was ordered back to Atlanta, Georgia, from Columbia, South Carolina, and on the 27th of the same month Battery I, Third Artillery, was ordered from Spartanburgh to Charleston, South Carolina.

On February 8 Company H, Seventh Cavalry, was ordered back to Nashville, Tennessee, from Huntsville, Alabama, and on February 29 Company C, Seventh Cavalry, was transferred from the post of Rutherfordton to Lincolnton, North Carolina.

On March 12 the post of Opelika, Alabama, was established, and garrisoned by Company D, Seventh Cavalry, ordered there from Chester, South Carolina.

On March 25 Company G, Fourth Infantry, was ordered from Frankfort to Paducah, Kentucky, and Company D, of the same regiment, from Paducah to Frankfort.

On April 25 Company G, Eighteenth Infantry, was ordered from Columbia to Chester, South Carolina.

On May 16 Company A, Second Infantry, left Atlanta, Georgia, for Montgomery, Alabama, and returned to its proper station July 8.

On August 13 Company G, Seventh Cavalry, was directed to proceed from Spartanburgh, South Carolina, to Laurensville, South Carolina, to take post, and on the 17th of the same month Company I, Eighteenth Infantry, was ordered from Columbia, South Carolina, to the same place.

In addition to these changes, more than one hundred and sixty temporary detachments have been made from the garrisons of posts for the purpose of aiding civil officers. These detachments have been made on the requisition or request of governors of States, sheriffs, and other local State civil officers, and United States marshals, district attorneys, and officers of the Internal Revenue Department. These detachments do not include those made in South Carolina to aid the civil authorities of the United States in the proclaimed counties of that State in the performance of their duties under the enforcement act. For a detailed account of the military operations in that section of the department, I refer to the inclosed report of Major Lewis Merrill, of the Seventh Cavalry. It affords me pleasure to be able to report that in every instance the conduct of the troops, while performing this delicate service, has been exemplary. The troops in the department are at the present time distributed as follows:

KENTUCKY.

Louisville.—Companies F, Seventh Cavalry; H, Fourth Infantry; A and E, Sixteenth Infantry.

Frankfort.—Companies D and K, Fourth Infantry.

Lexington.—Company A, Fourth Infantry.

Crab Orchard.—Company B, Fourth Infantry.

Paducah.—Company G, Fourth Infantry.

Mount Sterling.—Company E, Fourth Infantry.

Elizabethtown.—Companies A, Seventh Cavalry, and F, Fourth Infantry.

Lebanon.—Companies C and I, Fourth Infantry; (C, detached service, Lancaster.)

Shelbyville.—Company I, Seventh Cavalry.

Newport Barracks.—Recruiting depot.

TENNESSEE.

Nashville.—Companies H, Seventh Cavalry; F and G, Sixteenth Infantry.

Humboldt.—Company D, Sixteenth Infantry.

Chattanooga.—Companies E and I, Second Infantry.

ALABAMA.

Huntsville.—Company C, Second Infantry.

Mobile.—Companies G and K, Second Infantry.

Opelika.—Company D, Seventh Cavalry.

FLORIDA.

Saint Augustine.—Companies F and H, Second, and K, Sixteenth Infantry.

GEORGIA.

Fort Pulaski.—Batteries E and H, Third Artillery.

Savannah.—Battery K, Third Artillery.

Atlanta.—Companies A and B, Second, and A and E, Eighteenth Infantry.

NORTH CAROLINA.

Fort Macon.—Batteries K and L, Fourth Artillery.

Raleigh.—Batteries D and H, Fourth Artillery.

Rutherfordton.—Battery C, Fourth Artillery.

Lincolnton.—Company O, Seventh Cavalry.

Charlotte.—Battery A, Fourth Artillery.

Fort Johnston.—Battery G, Fourth Artillery.

SOUTH CAROLINA.

Charleston.—Light Battery C and Battery I, Third Artillery.

Columbia.—Companies B, D, and G, Eighteenth Infantry, (G temporarily at Chester.)

Chester.—Company H, Eighteenth Infantry.

Yorkville.—Companies K and L, Seventh Cavalry, and C, Eighteenth Infantry.

Newberry.—Company K, Eighteenth Infantry.

Unionville.—Companies E and M, Seventh Cavalry.

Spartanburgh.—Companies B, Seventh Cavalry, and D, Second Infantry.

Sumter.—Company F, Eighteenth Infantry.

Laurensville.—Companies G, Seventh Cavalry, and I, Eighteenth Infantry.

No change requiring mention has been made since the date of my last report in the method of furnishing the troops in this department with subsistence and quartermaster stores.

The sanitary condition of the troops is excellent; the medical supplies are ample and promptly furnished.

I inclose reports of the commanders of posts belonging to the department.

Very respectfully, your most obedient servant,

ALFRED H. TERRY,
Brigadier-General, Commanding.

The ADJUTANT GENERAL OF THE ARMY,
Washington, D. C.

HEADQUARTERS POST OF YORKVILLE,
Yorkville, South Carolina, September 23, 1872.

SIR: In compliance with Circular No. 19, Headquarters Department of the South, September 9, 1872, and your subsequent telegram, I have the honor to submit the following report:

The permanent changes which have taken place in this command during the past year, and the movements of this command and detachments thereof, permanent or temporary, during the same period, are presented in tabular form appended to this report.

GENERAL CONDITION OF THE TROOPS.

The garrison of this post consists of one field officer of the Seventh Cavalry, commanding post, one acting assistant surgeon, (medical officer,) one hospital steward, one veterinary surgeon of the Seventh Cavalry, two companies of the Seventh Cavalry, Company K, (Captain Hale,) Company L, (Lieutenant Wesson,) and one company of the Eighteenth Infantry, (Captain Christopher,) Company C.

The general condition of the troops is good, the officers in the main attentive, and faithful in their discharge of duty, and in personal habits exemplary. In point of discipline, while the troops do not fall below a fair standard, the circumstances of easy access to whisky-shops, and being stationed in a village where close supervision of conduct is by no means easy, without undue attempt to restrain the men from recreation, contribute to more looseness of conduct than would be found at a military post or camp away from such surroundings. Notwithstanding this the offenses against discipline are not extraordinary in either number or gravity. In their relations to the civilians among whom they are stationed the men are in the main inoffensive, and occasions are rare in which any trouble has arisen. In the few cases in which it has occurred there has been no instance in which the folly and misconduct of the civilian have not been the original incentive in bringing about difficulty.

Desertions from the several companies of the command have been unduly frequent, but whether in greater number than from commands similarly circumstanced I am unable to say. It has been impossible to recapture deserters owing to the ease with which they can get beyond reach before the fact of the absence being desertion is known, and the additional fact that the sympathies of the people are so much with deserters that little or no information is to be had from them when sought for. The desertions lately have been chiefly from the recruits, and in most of these cases of men who should never have been enlisted. For some reason the recruits sent to this command have been of lower grade than, under present inducements of pay, &c., should be enlisted in the service. From whatever cause this arises it is a serious and expensive evil.

I have no doubt, from various sources of information, and from careful observation, that desertions are encouraged and facilitated by Ku-Klux and their sympathizers. It is very difficult, and so far no success has attended the effort, to secure exact legal evidence on which those guilty might be brought to punishment, but there is every moral conviction that no effort has been spared by these persons to breed disaffection and dissatisfaction among the men. So far as I can observe there is no sympathy among either enlisted men or officers with the lawlessness which it might become their duty to assist in suppressing, and with the exception of deserters and one other case, I have had no reason to think that any one could have been induced to betray his duty.

The two noted have been the chief causes of desertions, though to these should be added some dissatisfaction with the quality and allowance of clothing, which I presume will cease so soon as the new uniform is furnished.

The health of the command has been exceptionally good. No epidemic diseases have appeared, and there has been but little sickness. Three deaths only have occurred, two from disease or injury contracted before coming here, and one from falling from a window while in fever delirium. Most of the unfitness for duty has been from accidental injuries, among which has been a remarkable fact that in the last year

fire men have fallen from windows, resulting in one death, one amputation of a leg, and serious injury in three other cases. There is nothing remarkable about the placing of the windows which should bring such a result.

The climate is very fine both winter and summer, and as healthful and pleasant as any in which I have ever lived.

The health of the horses has been good in the main, and their condition fine except for glanders appearing among them. The disease appears to have been brought here by the horses purchased at Louisville. It is stated that it appeared there before they were shipped, which, if the fact, should have induced the quartermaster shipping them to give notice of it so that due precaution might have been taken in time to prevent its spread. So far four have been shot, and I fear that several more will be lost by reason of it. Every precaution is taken to prevent its spread.

The instruction of the men has been such as the climate and constant calls for duty permitted. It is far from being up to the standard, but I think quite equal to the average of the service, and as good and thorough as the circumstances and peculiar duty have permitted. So long as recruits are sent to the cavalry companies with practically no knowledge whatever of their duties, the instruction of the cavalry will fall far short of even a respectable standard, because it is almost always the fact that the circumstances of duty are such that but small opportunity is to be had to lay any thorough groundwork of either horsemanship or elementary drill. From this arise want of accuracy in the drill and the formation of habits of carelessness and slouchiness, which are very hard to eradicate, even if opportunity to do it should be found.

The officers, as seems in the nature of things universal and unavoidable in the service, are not well instructed professionally. While commendably faithful and attentive to duty, constant service with small commands and under circumstances which afford little time and no facilities for theoretical instruction, has tended to bring about a degree of satisfaction with low professional attainments, and with ability to discharge simply routine duty, which is highly detrimental to the best interests of the service. Situated as this command is there is no present remedy save to encourage every individual effort toward a better knowledge of the profession, a remedy wholly inadequate to the evil.

MANNER IN WHICH THE TROOPS ARE QUARTERED.

The two cavalry companies occupy a large brick building, formerly a hotel, situated on the main street, near the center of the village. This building comfortably accommodates both companies with their kitchens and mess-rooms, and also furnishes rooms for guard-house and post reading-room. Belonging to this building is a stable which shelters indifferently, but sufficiently well the horses of one company. The horses of the other company are sheltered in a fair stable in close vicinity, (just across the street.) The infantry company is quartered in a wooden building on the opposite side of the street from the cavalry, but in close vicinity. The building answers the purpose as well as buildings not intended for such use could do. On the next lot to the infantry quarters is the building used for a hospital, which is reasonably adapted to its use, and of sufficient accommodation for the sick likely to be found in this command.

The laundresses, save such as prefer to hire their own quarters, are accommodated in a building in the outskirts of the town.

For the present and until the weather becomes rough and cold the guard and prisoners are kept in tents on open ground not far from the quarters.

The officers are quartered in houses and a hotel reasonably convenient to the quarters of the troops.

The supplies are stored in an isolated building, which also furnishes rooms for the post quartermaster and commanding officer's offices.

The total rental paid for buildings and stables is within the limit set by the commanding general, and is less than would be the wear and tear of the necessary canvas, and for that reason the troops were not moved into camp during the summer.

SUPPLIES.

Subsistence stores, except fresh beef, are furnished from the depot at Columbia, and have been abundant, good, and promptly supplied, except one small invoice of flour and a few barrels of pork, which were inferior and bad. These were reported on at the time their quality was discovered. Fresh beef is supplied by purchase in the open market. It is of inferior quality and high in price, owing to the fact that this section raises no stock, and there is scarcely any business energy among the people, and little market for fresh meat outside the troops, and so no competition among persons to supply beef.

Early in the spring I directed the several company commanders to secure ground and prepare gardens for the use of their companies. They have been very successful, notably Captain Hale, who had better ground than the others, and the gardens have furnished a large supply of fresh vegetables to the companies. Aside from the gardens of the companies it would have been difficult, if not impossible, to procure needful supplies of vegetables. The effect of abundant supplies of vegetables on the health and contentment of the men has been excellent, and the gardens have shown how much it is possible to add to the comfort and well-being of the men by a small expenditure of time and effort of this kind on the part of company commanders. It is the first time that any of them have had any great success in gardening, and this experience is likely to be valuable to their companies in the future. Quartermaster's stores have been furnished from the various depots of that department.

Forage since July last has been furnished by the contractor delivery here. Thus far the supplies have been abundant and good. Some embarrassment has arisen from the contractor having to ask the post quartermaster to act as his agent for the payment of freight, having no agent here. The practice might prove objectionable, and I would recommend that it be discouraged whenever possible.

Fuel has been supplied by purchases of wood in the open market. It is of inferior quality and uncertain in supply. This is owing to the want of energy and business tact of the people here. Wood and water are the two things which nature has most abundantly supplied here, but the people seem never to think of preparing any fuel until it is needed for immediate use, and then the chief supply is either green wood or half rotten windfalls.

For the supply of troops the resources of the country furnish nothing save fuel and lumber if needed.

GENERAL INFORMATION.

The organization, purposes, and conduct of the Klu-Klux Klan have been so fully reported upon previously that it is needless for me to add

anything to those reports. All that was then at the various dates reported has been abundantly confirmed by subsequent developments. The general history of the relations of this command to that conspiracy, and of the conspiracy itself, are recounted in my previous reports, to which I beg to invite your attention for any facts relating to it.

Since my latest reports the work of arresting such as there was process for has gone on by the United States marshal and his deputies, in most cases assisted by small detachments of troops. These are furnished whenever asked for. The arrests now are difficult because of the efforts to evade them, but no serious apprehension exists of resistance when troops accompany the deputies. I consider it advisable in most cases to have troops accompany the deputies, because the temptation to resistance and perhaps fatal consequences is thereby avoided. Were the deputies to attempt by themselves to make the arrests I feel sure that in some cases resistance would be attempted, and also that if troops were not present there would no doubt be some attempts at rescue after the arrest is effected.

In only one case has any serious consequence resulted from an attempt to arrest. In April last, one Minor Parris was shot while evading arrest. The facts were fully reported at the time, and that report is referred to for any further information which is needed. The facts, in my estimation, justified the shooting, and this judgment is confirmed by the investigation and verdict of the coroner's jury, which justifies the conduct of the *posse* which resulted in Parris's death. This is the only case in which violence was necessary or was used. Prudence, firmness, and good sense on the part of the officers and men used as *posses* have prevented violence, to which the conduct of many of the persons arrested was strongly provocative, so much so that great forbearance was not unfrequently necessary.

In my report of January 17 last I expressed the hope and opinion that it would not be long before the efforts of the better men here and their influence on public sentiment would supersede the necessity for the interposition of the military forces of the national Government. I regret to say now that events since then do not justify that opinion, and that I am forced now to think it was premature. It was, of course, too much to hope that there would be any sudden regeneration of sentiment among people who were so blinded by ignorance and prejudice, and so misled by men whose passions and irreconcilable hostility to the results of the war led them to look with allowance, at least, when it was not open approval, on such inhuman barbarities as were practiced by the Ku-Klux; but it was reasonable to expect that the severe lesson to be learned from the sudden collapse of the organization, and the flight or arrest of its leading men, would have had a very wholesome effect in silencing bad counsel and inducing the dupes to be more wary of following it when given. The fact, however, appears that either through ignorance or prejudice, or both combined, the majority of the whites here learn but little by experience. The wildest and most absurd rumors set afloat through the country are received with amazing credulity. Stories of the pardon of those convicted, of the successful overthrow in the Supreme Court of the laws under which the prosecutions were had, of Executive disapproval of my conduct and my consequent removal from command, of Executive orders to the judges of the United States courts to hear no more Ku-Klux cases, and similar absurd tales, have one after another spread like wild-fire over the country, and have been for the time being believed implicitly. The readiness with which they were credited and the congratulatory comments of the hearers, not

unfrequently coupled with threats of what would now happen to the negroes and to such white men as had been witnesses, go to show how deep-seated are the causes from which all this lawlessness has sprung, and how ready these same people would be to renew in the same or some other form the efforts of the past.

While it is true that good men are more free in expression of denunciation of Ku-Kluxism than before, the tyranny of that organization over public opinion was so nearly perfect that its effect will be for a long time very great. So strong is this effect still that it is idle to expect for a long time to come that the State laws will be enforced in any Ku-Klux cases. One notable instance in Chester County shows what the condition of public sentiment is there. A case was recently tried before the State court in which the evidence most conclusively established a deliberate and cold-blooded murder of a negro man by a white man, "a Ku-Klux;" but the jury, composed wholly of white men, acquitted the murderer with scarcely any hesitation. In this county it is no better, and I doubt the possibility of bringing any offender to justice before the State courts, no matter how plain the evidence, where the offense has any immediate or remote relations to the Ku-Klux organization.

The administration of government in this State in the present condition of society demands qualities of wisdom, honesty, and executive ability which are wholly wanting in the majority of the public officers, and there appears no reasonable ground for expecting anything better. Between ignorance among the [*sic*] of the voters, and blind, unreasoning, and sullen stubbornness among the intelligent whites, resulting in the control of public affairs by men of whom the major part are both dishonest and incompetent, the condition of things here is such as leaves little to hope for in the near future. What remedy there is for it, save such as time and education may afford, is not easy to see; but it is gravely to be apprehended that it may result in anarchy in its worst form before these means have time to effect the result.

The only laws which have any chance for just execution in protecting the citizen are those of the United States. The machinery for the execution of these never contemplated such a state of affairs as has existed, and still exists, here, and in consequence is wholly inadequate to the task. The United States courts are choked with a quantity of business which amounts practically to a denial of a hearing of four-fifths of the cases which are before them, while even this number of cases is but a small percentage of the gross violations of law which are cognizable by those courts. Public sentiment does not condemn law-breaking, or demand its punishment, except in cases where negroes are the law-breakers, or in gross cases of whites against whites. To a degree that is surprising and disgraceful negro labor is swindled out of its earnings, and this with hardly a remedy. Public officers generally are shamefully negligent of duty, and notably deficient in conscientious disposition to do right. The obligations of public office are disregarded, either from corrupt motives or from utter incompetency, to an extent that is hardly credible, coupled as it is with its tolerance or excuse by those who certainly know better. In the courts the sacredness of the obligation of an oath is disregarded, to an extent and by individuals of a social grade that would be incredible elsewhere; it is done, however, with impunity. Public sentiment excuses and palliates it when done in the defense of Ku-Klux, and so encourages it in other matters. So long as the very fountains of justice are polluted in this way, and it meets with hardly

condemnation, there is small hope for the good order or well-being of society.

Such a state of things as exists here and elsewhere in large sections of this State is so hopeless of any promise of good for the future, and so disgraceful to the whole country, that it has been with the greatest reluctance I have compelled myself to believe that these are the facts. I have come very slowly to the belief, and only on such multiplied evidence as would convince the most incredulous, if at all fair-minded. In my experience it has no parallel, either in the wanton and brutal cruelties inflicted or approved and encouraged by the majority of the whites, or in the utter deadening of the moral sense in large parts of whole communities commonly reputed and believed to be far removed from the barbarism of savages.

As matters now stand, the only protection which citizens can look to with any assurance is the General Government; the only laws justly enforced are those of the United States; and even this would avail but little if it were not for the moral effect of the presence of United States troops, and the feeling among the people that violation of United States law will be promptly and fully investigated, and the perpetrators brought to justice if possible.

Lest I may be misunderstood, I wish to add that I do not consider that it is either necessary or advisable for the military to interfere, except so far as they may be called upon by proper authority, but I do think the moral effect of their presence absolutely essential to any approximation to good order and observance of or enforcement of law.

I am, sir, very respectfully, your obedient servant,

LEWIS MERRILL,

Major Seventh Cavalry, Commanding Post.

The ADJUTANT-GENERAL,

Department of the South, Louisville, Kentucky.

Permanent changes at post of Yorkville, South Carolina, since September 30, 1871.

Date of report-
ing for or be-
ing relieved
from duty at
the post.

- Oct. 12, 1871. Company B, Eighteenth Infantry, from Columbia, South Carolina, per Special Orders No. 108, Headquarters Post of Columbia, South Carolina, October 11, 1871.
- Oct. 14, 1871. Troop D, Seventh Cavalry, from Columbia, South Carolina, per Special Orders No. 108, Headquarters Post of Columbia, South Carolina, October 11, 1871.
- Oct. 14, 1871. Troop L, Seventh Cavalry, from Winnsborough, South Carolina, per telegraphic instructions received at that post.
- Nov. 15, 1871. Acting Assistant Surgeon T. C. Skrine, United States Army, from Winnsborough, South Carolina, per Special Orders No. 116, Headquarters Post of Columbia, South Carolina, October 29, 1871.
- Nov. 18, 1871. Troop D, Seventh Cavalry, transferred to post of Chester, South Carolina, per Special Orders No. 83, Headquarters Post of Yorkville, South Carolina, November 17, 1871.
- Dec. 5, 1871. Acting Assistant Surgeon William A. Tompkins, United States Army, transferred to Post of Unionville, South Carolina, per Par. II Special Orders No. 246, Headquarters Department of the South, November 23, 1871.
- Dec. 8, 1871. First Lieutenant James H. Bradley, Eighteenth Infantry, B, transferred to Seventh Infantry, per Special Orders No. 457, War Department, Adjutant-General's Office, Washington, D. C., November 23, 1871.

- Dec. 9, 1871. Assistant Surgeon Joseph R. Gibson, United States Army, arrived at post, per Par. II Special Orders No. 252, Headquarters Department of the South, Louisville, Kentucky, December 2, 1871.
- Dec. 13, 1871. Acting Assistant Surgeon T. C. Skrine, United States Army, contract annulled, per Par. II Special Orders No. 101, Headquarters Post of Yorkville, South Carolina, December 13, 1871.
- Dec. 22, 1871. Hospital Steward Arthur M. Reybold, United States Army, arrived at Post, per Par. II Special Orders No. 261, Headquarters Department of the South, Louisville, Kentucky, December 16, 1871.
- Dec. 22, 1871. Acting Assistant Surgeon John Harvey, United States Army, from Unionville, South Carolina, per Par. III Special Orders No. 246, Headquarters Department of the South, November 23, 1871.
- Jan. 18, 1872. Company B, Eighteenth Infantry, transferred to Post of Columbia, South Carolina, per telegraphic instructions received from headquarters Department of the South, dated January 15, 1872.
- Mar. 19, 1872. First Lieutenant Henry J. Nowlan, Seventh Cavalry, L, appointed regimental quartermaster of the Seventh Cavalry; relieved from duty at post, per Special Orders No. 56, current series, Headquarters Post of Yorkville, South Carolina.
- Mar. 23, 1872. Acting Assistant Surgeon John Harvey, United States Army, transferred to post of Lincolnton, North Carolina, per Special Orders No. 55, current series, Headquarters Department of the South.
- Apr. 13, 1872. First Lieutenant J. F. Weston, Seventh Cavalry, joined Troop L, from detached service at regimental headquarters Seventh Cavalry.
- May 3, 1872. Veterinary Surgeon John Tempanny, Seventh Cavalry, arrived at post, per Par. II Special Orders No. 84, current series, Headquarters Department of the South.
- June 5, 1872. Acting Assistant Surgeon R. G. Redd, United States Army, arrived at post, per Par. I Special Orders No. 112, current series, Headquarters Department of the South.
- June 26, 1872. Assistant Surgeon Joseph R. Gibson, United States Army, transferred to Charleston, South Carolina, per Par. II Special Orders No. 112, current series, Headquarters Department of the South.

Respectfully submitted.

LEWIS MERRILL,
Major Seventh Cavalry, Commanding Post.

HEADQUARTERS DEPARTMENT OF THE GULF, *New Orleans, Louisiana, October 4, 1872.*

SIR: In compliance with instructions of the 23d September, I have the honor to submit the following report of operations in this department from November 28, 1871, up to this time. This does not embrace the full military year, as I did not assume command, and was not in the department, until the date last mentioned.

Application was made for the records of this department for the time preceding my command, but it was not found practicable to furnish them.

This department embraces the States of Louisiana, Arkansas, Mississippi, and the Gulf posts as far eastward as (and embracing) Key West, Florida. The military posts in the harbor of Mobile are excepted, and not in the command.

The present force in the department consists of two companies of cavalry, six batteries of artillery, four companies of the Sixteenth and the entire regiment of the Nineteenth Infantry, with an aggregate strength (August 31, 1872) of 1,149. The troops are distributed as follows:

LOUISIANA.

Baton Rouge.—Headquarters and Companies A, B, F, G, and I, Nineteenth Infantry.

Jackson Barracks.—(In camp at East Pascagoula,) Companies C, D, and H, Nineteenth Infantry.

ARKANSAS.

Little Rock.—Company K, Nineteenth Infantry.

MISSISSIPPI.

Jackson.—Companies B, H, and I, Sixteenth Infantry.

Aberdeen.—Company C, Sixteenth Infantry.

Holly Springs.—Company E, Nineteenth Infantry.

Oxford.—Company I, Sixth Cavalry.

Meridian.—Company K, Sixth Cavalry.

FLORIDA.

Fort Barrancas.—Batteries G, L, and M, Third Artillery.

Fort Jefferson.—Battery F, Third Artillery.

Key West.—Batteries B and D, Third Artillery.

During the ten months covered by this report the following changes and movements of the troops have taken place:

On December 12, 1871, the post of Meridian, Mississippi, was discontinued, and the company stationed there transferred to Jackson, Mississippi.

On January 5, 1872, Companies G and I, Nineteenth Infantry, were brought temporarily from Baton Rouge to New Orleans, Louisiana, and on January 7, Companies A and H, Nineteenth Infantry, followed them.

On January 27, 1872, Companies I and K, Sixth Cavalry, arrived in this department from the Department of the Missouri, and took position at Oxford and Saltillo, Mississippi; and on March 15, Company K was moved from Saltillo to Meridian.

On January 27, 1872, Companies A, G, and I, Nineteenth Infantry, returned to Baton Rouge, Louisiana.

On June 28, 1872, Company F, Nineteenth Infantry, was transferred from Jackson Barracks to Baton Rouge.

On June 28, 1872, the garrison of Jackson Barracks, Louisiana, consisting of Companies C, D, and H, Nineteenth Infantry, moved to the Government reservation at East Pascagoula, Mississippi.

On August 12, 1872, Company H, Sixteenth Infantry, was ordered to take temporary post in the vicinity of McComb City, Mississippi.

On August 19, 1872, Batteries L and M, Third Artillery, were moved from Fort Jefferson to Fort Barrancas, Florida.

In addition to these principal changes in the station of troops, about forty detachments have been furnished from the garrisons of the posts for the purpose of aiding civil officers. These detachments have all been made upon the written requisitions of United States marshals, except in two instances, where the requisitions were made by the governors of States, and in all cases, as far as the facts could be ascertained, these civil officers would not have been able to perform their duties without military protection, and I think I can aver with absolute certainty, that in no case have the troops, or any official, directly or indirectly connected with them, been used for the attainment of any partisan object whatever.

Their use has been solely in the interest of law and order, and in no case has this action been such as to incur the displeasure of any class of the community; on the contrary, as far as my information goes, their

action has been satisfactory to all good citizens and property-holders, of both political parties, in the communities in which their aid has been invoked.

The *emeute* of January 5, and the days following, which threatened such disaster to the commerce and prosperity of the city of New Orleans, may require some special notice in this report.

A short time after taking command of this department, and before sufficient time had elapsed to enable me to familiarize myself with the situation, this community became very much excited and its business relations greatly disturbed. The animosities growing out of the excitement seemed to be directed against the governor of the State, and the portion of the legislature acting in concert with him.

The financial condition of the State generally, and more particularly of the city of New Orleans, was such, and is still such, that the taxes on real estate in the city of New Orleans amount to between 5 and 6 per cent.; in fact, if the laws are rigidly enforced, the effect would be the same as if the property were confiscated. The community, with what justice it is not for me to say, attributed this condition of things to corrupt legislation and maladministration, and the state of affairs, bordering on insurrection, was in fact but an outcrop of the dissatisfaction felt by the property-holders and tax-payers of the city, who appeared to have no confidence in the ballot-box or the judiciary of the State to redress their grievances.

After the storm was raised by the free expressions of dissatisfaction on the part of leading citizens, and the opposing parties began marshaling their forces for the fray, the property-holders of the city and the great mass of law-abiding citizens saw that the direction of the insurrectionary forces was in the hands of chieftains not of their own selection, and with whom they were not in accord, and that they had raised a force they could not control. New issues were developed, which looked as if the controversy between the contending factions had degenerated into a scramble for place and the possession of the State treasury.

A committee of fifty or seventy citizens, representing the wealth and business men of the city, believing that the movement was likely to end in a bloody riot, which would be disastrous to the prosperity of the city and to its commerce, which at that season of the year was at its culminating point, became alarmed and solicited the interposition of United States troops—in fact asked for martial law. The governor and his party, whom the discontented citizens were opposing, sought at that same time the interposition of United States troops.

The emergency was so sudden, and the demand was so urgent from both contending parties, particularly from the governor, whose letters are appended, (see Appendix A.) and having at the same time before my mind the fatal results of delay in the terrible events which happened here in 1866, I did not hesitate to take the responsibility, and ordered the troops to the front, and telegraphed to the War Department what I had done, and my course was approved. The presence of the troops allayed excitement, and probably prevented collision of armed bodies. The troops, and those who commanded them, however, took no part whatever in any of the discussions, arrests, or any other acts of the contending parties, and it cannot be said, with the shadow of truth, that the action of the troops or those who controlled their movements had any other object or effect than to hold the situation in the interest of justice and peace, and give an opportunity to the parties

aggrieved to seek redress through legitimate channels. At no time was the General Government or its troops a party to the contest.

After the lapse of a few days, everything being quiet, and believing that the presence of the troops would be used to perpetuate abuses by the State authorities upon a loyal and hospitable people, I withdrew the troops, first giving both the contending parties notice of my intention, and apprising the War Department of my intention to do so. This act was also approved at Washington, and it had the effect which I anticipated, the immediate repeal of the obnoxious laws; those laws under the operation of which the State and city are supposed to have been brought to their then condition.

Unfortunately, this repeal of the obnoxious laws was not in earnest. The whole thing was a sham, and upon its discovery the movement to dispossess the governor and his party was again organized, and a very considerable armed force was marshaled to attack the governor and his party, who were barricaded in the building occupied as a state-house, which was defended by artillery.

The day but one before the intended attack, the leader of the attacking party issued a proclamation stating his intention to assault the capitol, and asking merchants in the streets adjacent to close their stores, and warning non-combatants to keep out of the way.

I had come by this time to thoroughly understand the situation, and it was my intention not to interfere unless ordered to do so by higher authority, which authority was kept informed by telegraph of all that was passing. The threatening proclamation above referred to was communicated in full by the State authorities to the President, and was telegraphed in every direction by the press. This caused serious apprehensions all over the country, in which, I confess, I did not participate. As might have been expected, however, when the news of this proclamation reached the President, orders were given me to prevent any collision between armed bodies of men.

These instructions, to prevent collision, were communicated by me to the chieftains of the opposing forces the moment they were received, and it is due to the person marshaling the attacking force to say that immediately upon the receipt of a copy of the President's instructions, he at once disbanded his forces, and the *emeute* was at an end.

I think it not out of place to say that during these very serious difficulties the officers and men lately in arms against us acted with admirable forbearance, and very generally expressed to me personally their desire to take no part in any domestic difficulty, but avowed their intention, if required to take any part, to render every aid in their power to the officers of the General Government in maintaining peace.

The whole subject of these difficulties was thoroughly investigated by the committee of Congress who came here for that purpose, and the elaborate report made by that committee, which has been printed by Congress, makes unnecessary any more detailed narration of events connected with it. There will be found in that report copies of all communications between the Government and myself, and between myself and the State authorities and the citizens, touching this matter.

During the period embraced in this report, the health of this command has been unprecedented. There have been but thirteen deaths in that time, and during the present season not a single case of malignant or yellow fever.

I strongly recommend the continuance of the system recently inaugurated of moving the troops from the forts to convenient camping-grounds

or barracks, and leaving the forts in charge of small guards. To this system I attribute the improved health of the troops.

The discipline of the troops has been very satisfactory, considering the detached character of the service they have been required to perform.

The staff departments as now organized are also in a very satisfactory condition, and all their duties are performed with promptness and economy. A consolidation has been made of all the offices into one building, and all the store-houses under one roof, at a saving to the Government of about ten thousand dollars a year.

From this consolidation the subsistence department has been necessarily excepted. In addition to supplying this department the chief commissary is charged with most of the supplies that go to Texas, and it was not found necessary or proper to make any retrenchment or reduction in the store-room required by him.

The inclosed memoranda of gain and loss in the forces are furnished for reference.

I have the honor to be, very respectfully,

W. H. EMORY,
Colonel Commanding.

The ADJUTANT-GENERAL OF THE ARMY,
Washington, D. C.

STATE OF LOUISIANA, EXECUTIVE DEPARTMENT,
New Orleans, January 5, 1872.

U. S. GRANT, *President United States, Washington, D. C. :*

Danger of a riot and tumult is imminent. There is no quorum in the senate, and hence the legislature cannot call on you for assistance. The absent senators are on the United States revenue-cutter *Wilderness*.

I respectfully ask that General Emory be instructed to co-operate with me in preserving the peace, and protecting the government from attack and overthrow.

H. C. WARMOTH,
Governor of Louisiana.

[Official copy furnished General Emory by Governor Warmoth.]

A true copy.

W. T. GENTRY,
Captain Nineteenth Infantry, A. A. A. G.

STATE OF LOUISIANA, EXECUTIVE DEPARTMENT,
New Orleans, January 5, 1872.

GENERAL: The condition of affairs is such that it is necessary that I should have an interview with you, and I am advised that it would be injudicious for me to leave the capitol at the present time. I therefore respectfully request that you will do me the honor to call upon me immediately at my office.

Very respectfully, your obedient servant,

H. C. WARMOTH,
Governor of Louisiana.

Major-General EMORY,
Commanding Department of the Gulf.

A true copy.

W. T. GENTRY,
Captain Nineteenth Infantry, A. A. A. G.

STATE OF LOUISIANA, EXECUTIVE DEPARTMENT,
New Orleans, January 5, 1872.

[Extract.]

GENERAL :

Since the troops were dismissed from the vicinity of the state-house, I am in receipt of information which leads me to recommend that the troops under your command be kept within easy call during to-day and to-morrow.

Very respectfully, your obedient servant,

H. C. WARMOTH,
Governor of Louisiana.

Major-General EMORY,
Commanding Department of the Gulf.

A true copy.

W. T. GENTRY,
Captain Nineteenth Infantry, A. A. A. G.

STATE OF LOUISIANA, EXECUTIVE DEPARTMENT,
New Orleans, January 5, 1872.

[Extract.]

GENERAL :

I take this opportunity to thank you for the promptitude with which you responded to my request, through General Longstreet, to co-operate with me in preserving the peace, and I respectfully request you to incamp your troops and artillery in close proximity to the state-house during the night.

Very respectfully, your obedient servant,

H. C. WARMOTH,
Governor of Louisiana.

Major-General EMORY,
Commanding Department of the Gulf.

A true copy.

W. T. GENTRY,
Captain Nineteenth Infantry, A. A. A. G.

STATE OF LOUISIANA, EXECUTIVE DEPARTMENT,
New Orleans, January 6, 1872.

GENERAL : On the application of Hon. H. O. Brewster, speaker of the house of representatives, and upon the affidavit of a brother of one of its members, and with the advice of the best legal authorities in the State, a writ of *habeas corpus* has been applied for to the honorable the judge of the eighth district court of the parish of Orleans. The writ is now being served by the sheriff. Should arrest be resisted and I called upon to assist in executing the order of the court, I shall use the power at my command, and in the event of my being unable to serve the paper and to preserve the peace with my present forces, I most respectfully request that you will repair to the scene of action without further notice, to aid me in enforcing the law and in preserving the peace and dignity of the State.

Very respectfully, your obedient servant,

H. C. WARMOTH,
Governor of Louisiana.

Major-General EMORY,
Commanding Department of the Gulf.

A true copy.

W. T. GENTRY,
Captain Nineteenth Infantry, A. A. A. G.

REPORT OF THE SECRETARY OF WAR.

STATE OF LOUISIANA, EXECUTIVE DEPARTMENT,
New Orleans, January 8, 1872.

GENERAL: The following telegram from General George Baldy, of the board of metropolitan police commissioners, has been received at this office, and is herewith respectfully submitted for your information:

"To Governor WARMOTH:

"A battery of four guns was seen by Army officers last evening, about thirty miles above here, on right bank, moving toward the city. The command appears to be in citizens' clothes.

"GEORGE BALDY."

To which the following supplementary telegram has been received:

"To Governor WARMOTH:

"Captain O'Reilly, of the Nineteenth Infantry, is my authority. He says several other officers saw the same.

"GEORGE BALDY."

Very respectfully, your obedient servant,

H. C. WARMOTH,
Governor of Louisiana.

Major-General EMORY,

Commanding Department of the Gulf.

P.S.—Detectives have been ordered to be sent to ascertain the facts.

A true copy.

W. T. GENTRY,
Captain Nineteenth Infantry, A. A. A. G.

STATE OF LOUISIANA, EXECUTIVE DEPARTMENT,
New Orleans, January 10, 1872.

[Extract.]

GENERAL: * * * * *

I respectfully request you to place your command on Canal street, near the Clay statue, at the earliest possible moment, that you may be able to assist me in suppressing any riotous demonstrations that may be made. The presence of your troops will be sufficient to prevent any disturbance whatever.

Very respectfully, your obedient servant,

H. C. WARMOTH,
Governor of Louisiana.

Major-General EMORY,

Commanding Department of the Gulf.

A true copy.

W. T. GENTRY,
Captain Nineteenth Infantry, A. A. A. G.

STATE OF LOUISIANA, EXECUTIVE DEPARTMENT,
New Orleans, January 11, 1872.

GENERAL: Affairs have assumed such a shape now that I think danger of riot or tumult has about passed. I write to say that I think by to-morrow at 12 o'clock you can safely withdraw your troops to the barracks.

I cannot let the opportunity pass to thank you and your troops again for your prompt and efficient services in the interests of peace and order during the past two days, and to assure you of my highest consideration and regard for yourself.

I have the honor to be, very truly, yours,

H. C. WARMOTH,
Governor of Louisiana.

Major-General EMORY,

Commanding Department of the Gulf.

A true copy.

W. T. GENTRY,
Captain Nineteenth Infantry, A. A. A. G.

STATE OF LOUISIANA, EXECUTIVE DEPARTMENT,
New Orleans, January 13, 1872.

GENERAL: I have just learned that an opposition party of several thousand men are prepared to make a riot to-day at noon, and that threats are made that not a stone of the State capitol shall be left upon another after they are through with their work. It is probable that these reports are sensational, yet, as a matter of precaution, I would respectfully suggest that you recall all of your forces to the city as speedily as possible.

I am, very respectfully, your obedient servant,

H. C. WARMOTH,
Governor of Louisiana.

Major-General W. H. EMORY,
Commanding Department of the Gulf.

A true copy.

W. T. GENTRY,
Captain Nineteenth Infantry, A. A. A. G.

STATE OF LOUISIANA, EXECUTIVE DEPARTMENT,
New Orleans, January 14, 1872.

GENERAL: Your letter of to-day is at hand, and in reply let me respectfully call your attention to the dangerous condition of public affairs and the great necessity for you to continue the policy which you have followed so far.

I have studiously avoided bringing you into the question of which is the legal legislature, and I shall be careful not to do so in the future, but it is not contended by anybody that I am not the executive of the State, and as such, the legislature not having organized owing to the want of a quorum in the senate, I address you in accordance with section 4 of Article 4 of the Constitution of the United States and the orders of the War Department to which you called my attention a few days ago, and request you to bring your troops to the city at an early hour to-morrow morning in order to prevent or suppress domestic violence which is very seriously threatened, and which will be prevented by the simple presence of your troops.

Very respectfully, your obedient servant,

H. C. WARMOTH,
Governor of Louisiana.

Major-General W. H. EMORY,
Commanding Department of the Gulf.

A true copy.

W. T. GENTRY,
Captain Nineteenth Infantry, A. A. A. G.

STATE OF LOUISIANA, EXECUTIVE DEPARTMENT,
New Orleans, January 14, 1872—9.30 p. m.

MY DEAR GENERAL: I have positive information that Colonel Carter and his friends are swearing a large number of sergeants-at-arms into their service, and that a general arrest of members of the house and an attack will be made on the state-house some time during the next eighteen hours. I write this note in order to keep you posted on the situation.

Yours truly,

H. C. WARMOTH.

Major-General EMORY.

A true copy.

W. T. GENTRY,
Captain Nineteenth Infantry, A. A. A. G.

STATE OF LOUISIANA, ADJUTANT-GENERAL'S OFFICE,
New Orleans, January 6, 1872—11 a. m.

GENERAL: On behalf of his excellency the governor, I am directed to say that some reports have reached him that an armed band of citizens, consisting of fifteen hundred

or two thousand members, have associated together for the purpose of assaulting and breaking up the city police, and other riotous and disorderly purposes, and threatening immediate execution of their purpose, and that the particular and especial purpose of this threatened outbreak is to assault the office of his excellency, with the probable intent to commit great violence to his person. He therefore directs me to appeal to you to so dispose of the United States troops under your command as to have them convenient to the capitol of the State, the supposed objective point, with instructions, in case of riot, to crush it in its inception.

It is supposed that you may make such disposition of your forces without infringing any law or orders for your governance or your desire to pursue the strictest impartiality toward the political parties of the State.

I think proper to add, in the commercial interest of the city, that any violent outbreak of this kind will be attended with very disastrous consequences.

I remain, general, your most obedient servant,

JAMES LONGSTREET,
Adjutant-General Louisiana State Militia.

Major-General W. H. EMORY, U. S. A.,
Commanding Department of the Gulf.

A true copy.

W. T. GENTRY,
Captain Nineteenth Infantry, A. A. A. General.

STATE OF LOUISIANA, ADJUTANT-GENERAL'S OFFICE,
New Orleans, January 9, 1872.

[Extract.]

GENERAL: His excellency the governor directs me to respectfully suggest that you retain the United States forces now in the city, and that you apply for the additional regiment that has been placed at your disposal by the War Department.

He hopes that you will permit the expression of opinion that nothing but your exalted appreciation of honor and justice has thus far saved us from bloodshed.

I am, general, most respectfully, your obedient servant,

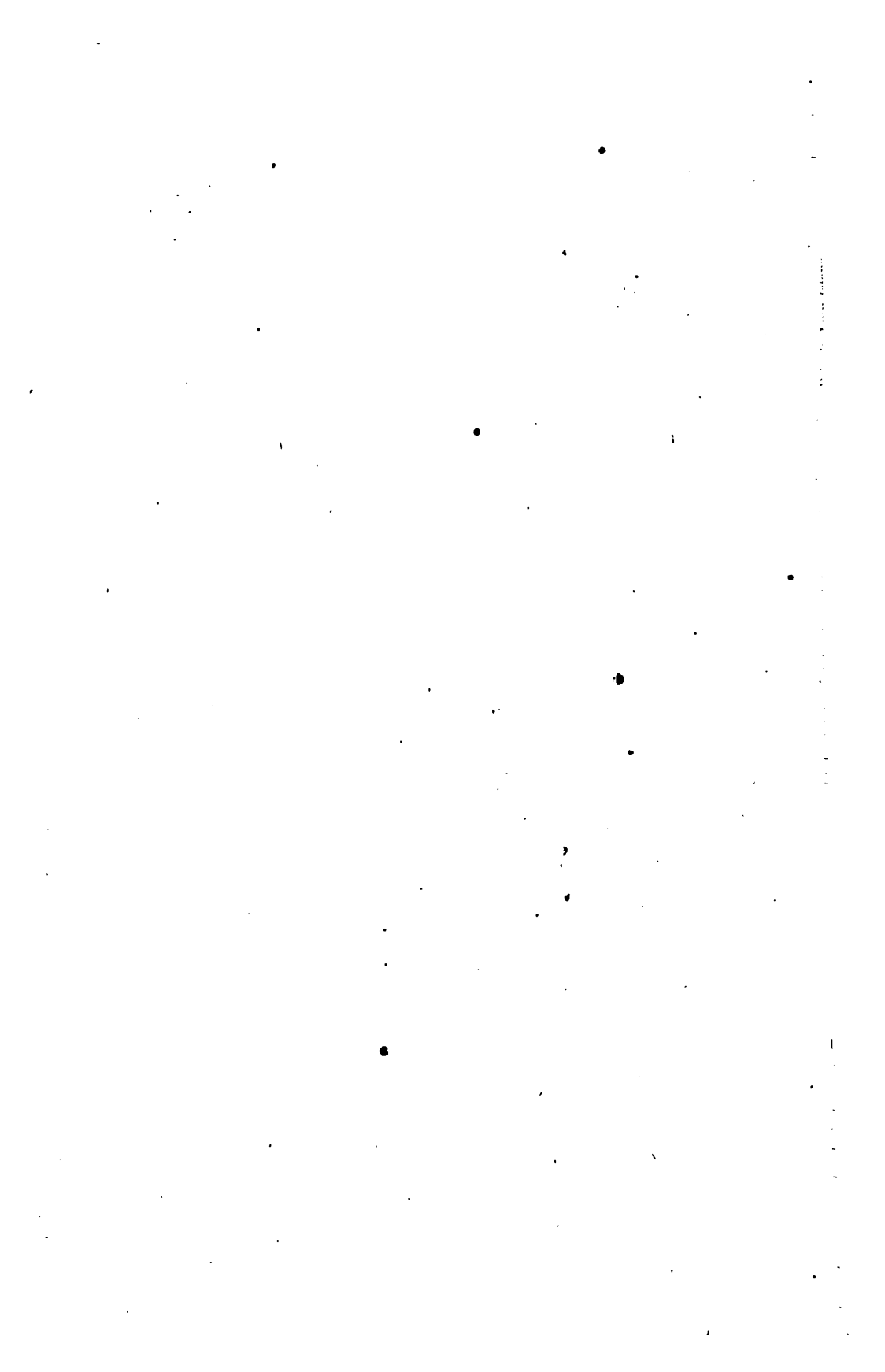
JAMES LONGSTREET,
Major-General Commanding Louisiana State Militia.

Major-General W. H. EMORY, U. S. A.,
Commanding Department of the Gulf.

A true extract copy.

W. T. GENTRY,
Captain Nineteenth Infantry, A. A. A. General.

REPORT OF THE ADJUTANT-GENERAL.



B.—GENERAL RETURN

General.

General officers.....	1
Military secretary to the Lieutenant General.....	
Aides-de-camp to general officers.....	
Adjutant General's Department.....	
Inspectors General.....	
Bureau of Military Justice.....	
Quartermaster's Department.....	
Subsistence Department.....	
Medical Department.....	
Pay Department.....	
Corps of Engineers.....	
Ordnance Department.....	
Chief Signal Officer.....	
Post chaplains.....	

First Regiment of Cavalry.....	
Second Regiment of Cavalry.....	
Third Regiment of Cavalry.....	
Fourth Regiment of Cavalry.....	
Fifth Regiment of Cavalry.....	
Sixth Regiment of Cavalry.....	
Seventh Regiment of Cavalry.....	
Eighth Regiment of Cavalry.....	
Ninth Regiment of Cavalry.....	
Tenth Regiment of Cavalry.....	

Aggregate of cavalry.....

First Regiment of Artillery.....	
Second Regiment of Artillery.....	
Third Regiment of Artillery.....	
Fourth Regiment of Artillery.....	
Fifth Regiment of Artillery.....	

Aggregate of artillery.....

First Regiment of Infantry.....	
Second Regiment of Infantry.....	
Third Regiment of Infantry.....	
Fourth Regiment of Infantry.....	
Fifth Regiment of Infantry.....	
Sixth Regiment of Infantry.....	
Seventh Regiment of Infantry.....	
Eighth Regiment of Infantry.....	
Ninth Regiment of Infantry.....	
Tenth Regiment of Infantry.....	
Eleventh Regiment of Infantry.....	
Twelfth Regiment of Infantry.....	
Thirteenth Regiment of Infantry.....	
Fourteenth Regiment of Infantry.....	
Fifteenth Regiment of Infantry.....	
Sixteenth Regiment of Infantry.....	
Seventeenth Regiment of Infantry.....	
Eighteenth Regiment of Infantry.....	
Nineteenth Regiment of Infantry.....	
Twentieth Regiment of Infantry.....	
Twenty-first Regiment of Infantry.....	
Twenty-second Regiment of Infantry.....	
Twenty-third Regiment of Infantry.....	
Twenty-fourth Regiment of Infantry.....	
Twenty-fifth Regiment of Infantry.....	

Aggregate of infantry.....

Non-commissioned staff unattached to regiments.....

ADJUTANT GENERAL'S OFFICE, 1872.

						TOTAL—		MILITARY ACADEMY.		
Artificers.	Saddlers.	Wagoners.	Privates—first class.	Privates—second class.	Privates.	Commissioned.	Enlisted.	Professors.	Cadets.	Aggregate.
						13				13
						15				15
						8				8
						10				10
						70				70
						26				26
						163				163
						54				54
			135	92		103	222			385
			204	121		61	441			502
						1				1
						30				30
	11	7			575	43	756			709
	12	4			580	43	753			796
	12	8			727	43	911			954
	12	12			716	42	913			955
	11	5			705	40	876			916
	12	12			757	43	923			966
	9	7			584	42	753			795
	12	8			555	42	727			769
	8	6			466	42	607			649
	10	9			357	43	488			531
	109	78			6,022	423	7,707			8,130
17		10			416	53	577			630
20		3			475	57	611			668
12		6			453	59	596			655
15		6			422	52	573			625
6		9			388	54	525			579
70		34			2,154	275	2,829			3,157
13		9			285	34	391			425
9		8			329	35	442			483
11		3			476	35	529			624
10		6			403	35	527			562
13		9			483	35	624			659
9		2			514	35	631			696
5		2			432	35	542			577
7		8			378	34	499			533
10		3			434	35	553			588
15		4			391	34	526			560
9		2			326	34	443			477
2		2			359	33	458			491
3					353	33	447			480
					412	35	524			559
10		5			411	35	505			540
15		7			370	33	500			533
7		6			357	34	462			496
13		5			346	35	460			455
5		6			371	34	488			522
5		2			381	34	499			533
3		4			392	33	489			522
6		3			405	34	520			554
16		7			382	33	496			531
5		9			464	22	588			620
9		6			474	33	599			632
210	118				9,026	852	12,810			13,662
							116			116

REPORT
OF
THE ADJUTANT-GENERAL.

ADJUTANT-GENERAL'S OFFICE,
Washington, October 12, 1872.

SIR: The Adjutant-General being temporarily absent in consequence of injuries received, I have the honor to herewith transmit, for him, the annual report of this office.

I am, sir, very respectfully, your obedient servant,

WM. D. WHIPPLE,

Assistant Adjutant-General.

The Honorable the SECRETARY OF WAR.

*C.—Position and distribution of troops in the Military Division of the Missouri, commanded
returns on file in the Adjutant-*

POSTS.	SITUATIONS.	COMMANDING OFFICERS.	GARRISONS.		PRESENT.				
			Number of companies.	Regiments.	General officers.	Military secretary.	Adjutant-general.	Inspector-general.	
DEPARTMENT OF DAKOTA.				Staff of Division.	1	1	2	1	1
Headquarters.....	Saint Paul, Minn.....	Maj.-Gen. W. S. Hancock.		Department staff.	1		3	1	
Fort Snelling, Minn.	5 miles below Saint Paul.	Col. G. Sykes, 20th Inf...	1	20th Inf.....					
Fort Ripley, Minn.	47 miles north of Sauk Rapids.	Capt. W. S. McCaskey, 20th Inf.	1	20th Inf.....					
Fort Wadsworth, D. T.	On Kettle Lake.....	Capt. J. S. McNaught, 20th Inf.	1	20th Inf.....					
Fort Cross, D. T....	At crossing of James River by the N. P. R. R.	Capt. H. G. Thomas, 20th Inf.	3	20th Inf.....					
Fort Totten, D. T....	On southeastern shore of Devil's Lake.	Lt.-Col. L. C. Hunt, 20th Inf.	2	20th Inf.....					
Fort Pembina, D. T.	On Red River of the North.	Capt. L. Wheaton, 20th Inf.	2	20th Inf.....					
Fort Sully, D. T....	On Missouri River, 318 miles above Sioux City, Iowa.	Col. D. S. Stanley, 22d Inf.	4	22d Inf.....					
Fort Rice, D. T....	On Missouri River, 760 miles above Sioux City, Iowa.	Col. T. L. Crittenden, 17th Inf.	12	8th and 17th Inf.					
Fort McKeen, D. T.	At crossing of Missouri River by the N. P. R. R.	Lt.-Col. D. Huston, jr., 6th Inf.		2 6th Inf.....					
Fort Stevenson, D. T.	On Missouri River, 923 miles above Sioux City, Iowa.	Maj. J. P. Roy, 6th Inf...	2	6th Inf.....					
Fort Randall, D. T.	On Missouri River, 146 miles above Sioux City, Iowa.	Lt.-Col. E. Otis, 22d Inf..	5	22d Inf.....					
Cheyenne agency, D. T.	On Missouri River, 7 miles above Fort Sully.	Capt. C. Boyd, 17th Inf..	2	17th Inf.....					
Lower Brulé ag'cy, D. T.	On Missouri River, 60 miles above Fort Randall.	Capt. John Hartley, 22d Inf.	1	22d Inf.....					
Grand River ag'cy, D. T.	On Missouri River, 90 miles above Fort Sully.	Capt. E. Collins, 17th Inf.	2	17th Inf.....					
Camp Baker, M. T....	18 miles northeast of Diamond City.	Capt. H. B. Freeman, 7th Inf.	1	7th Inf.....					
Fort Shaw, M. T....	On Sun River, 80 miles north of Helena.	Col. John Gibbon, 7th Inf.	7	7th Inf.....					
Fort Ellis, M. T....	In Gallatin Valley, 3 miles from Bozeman.	Maj. E. M. Baker, 2d Cav.	5	2d Cav. and 7th Inf.					
Fort Buford, D. T....	Near the mouth of the Yellowstone.	Col. W. B. Hazen, 6th Inf.	6	6th Inf.....					
Fort Benton, M. T....	On Missouri River, 143 miles north of Helena.	Capt. T. S. Kirtland, 7th Inf.	1	7th Inf.....					
Total.....			60		1		3	1	
DEPARTMENT OF THE PLATTE.									
Headquarters.....	Omaha, Nebr.....	Brig.-Gen. E. O. C. Ord...		Department staff.	1		3	1	
Omaha Barracks, Nebr.	4 miles above Omaha City	Col. I. N. Palmer, 2d Cav.	4	2d Cav., 8th & 9th Inf.					
Fort McPherson, Nebr.	On Platte River, 6 miles south of McPherson Station.	Col. J. J. Reynolds, 3d Cav.	4	3d Cav.....					
Camp Red Willow, Nebr.	Near junction of Red Willow Creek and Republican River.	Capt. J. D. Devin, 9th Inf.	3	2d & 3d Cav. & 9th Inf.					
Sidney Barracks, Nebr.	Near Sidney Station, on U. P. R. R.	Maj. N. A. M. Dudley, 3d Cav.	2	3d Cav. and 9th Inf.					

by Lieutenant-General P. H. Sheridan, headquarters Chicago, Illinois, taken from the latest General's Office, 1872.

PRESENT.																ABSENT.						PRESENT AND ABSENT.							
Bureau of Military Justice.	Quartermaster's Department.	Subsistence Department.	Medical Department.	Pay Department.	Corps of Engineers.	Ordnance Department.	Post chaplains.	Military store-keepers.	Colonels.	Lieutenant-colonels.	Majors.	Captains.	Regimental chaplains.	Regimental adjutants.	Regimental quartermasters.	Subalterns.	Enlisted men.	Total commissioned.	Aggregate.	General and staff officers.	Field and regimental staff officers.	Captains.	Subalterns.	Enlisted men.	Total commissioned.	Aggregate.	Commissioned officers.	Enlisted men.	Aggregate.
2	3	1	1	5	1												10	11	21	1					1	1	12	10	22
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			1									1					51	4	55		1		1		2	2	6	51	57
			1									3					156	7	163				3		3	3	10	156	166
				1						1		2					93	6	99				1	19	1	20	7	112	119
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											1	1					120	4	124		1	1	13	2	15	6	133	139	
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		1							1	1		4	1	1	6		385	15	400				1	12	1	13	16	397	413
												2					185	6	191		1	2	12	3	15	9	197	206	
			1								1	2					121	8	129					2		2	8	123	131

C.—Position and distribution of troops in the

		GARRISONS.		PRESENT.	
POSTS.	SITUATIONS.	COMMANDING OFFICERS.	Number of companies.	Regiments.	General officers. Military secretary. Adjutant-General's Dep't. Inspector-General.
DEPARTMENT OF THE PLATTE—Cont'd.					
Fort Sanders, W. T.	On line of the U. P. R. R.	Lt.-Col. G. P. Bradley, 9th Inf.	3	2d & 3d Cav. & 9th Inf.	
Fort D. A. Russell, W. T.	.....do.....	Col. J. H. King, 9th Inf.	9	3 Cav., 9th & 14th Inf.	
Fort Fred Steele, W. T.	.....do.....	Col. P. R. De Trobriand, 13th Inf.	2	2d Cav., 9th & 13th Inf.	
Fort Bridger, W. T.	10 miles south of Carter's Station, on U. P. R. R.	Maj. R. S. LaMotte, 13th Inf.	1	13th Inf.	
Fort Laramie, W. T.	89 miles north of Cheyenne City, on U. P. R. R.	Col. J. E. Smith, 14th Inf.	7	2d Cav. and 14th Inf.	
Fort Fetterman, W. T.	170 miles from Cheyenne City, on U. P. R. R.	Lt.-Col. G. A. Woodward, 14th Inf.	4	14th Inf.	
Camp Stambaugh, W. T.	67 miles from Point of Rocks, on U. P. R. R.	Maj. J. S. Brisbin, 2d Cav.	2	2 Cav. and 13th Inf.	
Camp Brown, W. T.	138 miles from Bryan, on U. P. R. R.	Capt. R. A. Torrey, 13th Inf.	1	13th Inf.	
Camp Douglas, U. T.	3 miles east of Salt Lake City.	Lt.-Col. H. A. Morrow, 13th Inf.	8	2d Cav. and 13th Inf.	
Beaver City, U. T.	.....do.....	Maj. J. D. Wilkins, 8th Inf.	4	8th Inf.	
Total			54		1 3 1
DEPARTMENT OF THE MISSOURI					
Headquarters	Fort Leavenworth, Kans.	Brig.-Gen. John Pope		Department staff.	1 2 1 1
Santa Fé, N. M.	Headquarters District of New Mexico.	Col. Gordon Granger, 15th Inf.		District staff.	
Fort Craig, N. M.	On the Rio Grande.....	Capt. J. H. Stewart, 15th Inf.	1	15th Inf.	
Fort Cummings, N. M.	At Cook's Springs	1st Lt. A. A. Humphreys, 15th Inf.	1	15th Inf.	
Fort Selden, N. M.	On the Rio Grande, 350 miles from Fort Union.	Maj. D. R. Clendenin, 8th Cav.	2	8th Cav.	
Fort Stanton, N. M.	On the Rio Bonita, 9 miles from Placita.	Capt. C. McKibbin, 15th Inf.	3	8th Cav. and 15th Inf.	
Fort Union, N. M.	5 miles from the Rio Moro, 387 miles from Sheridan.	Col. J. I. Gregg, 8th Cav.	4	8th Cav. and 15th Inf.	
Fort Bayard, N. M.	Near Pinos Altos, 448 miles from Fort Union.	Lt.-Col. T. C. Devin, 8th Cav.	4	8th Cav. and 15th Inf.	
Fort Wingate, N. M.	At the head-waters of the Rio Puerco.	Maj. W. R. Price, 8th Cav.	3	8th Cav. and 15th Inf.	
Fort Tulerosa, N. M.	114 miles west of Fort Craig.	Capt. F. W. Coleman, 15th Inf.	2	8th Cav. and 15th Inf.	
Fort Dodge, Kans.	96 miles southwest of Hays City.	Maj. R. I. Dodge, 3d Inf.	3	6th Cav. and 3d Inf.	
Fort Larned, Kans.	50 miles from Hays City.	Capt. H. B. Bristol, 5th Inf.	2	5th Inf.	
Fort Hays, Kans.	† mile from Hays City, on K. P. R. R.	Col. De L. Floyd-Jones, 3d Inf.	3	3d and 5th Inf.	
Fort Leavenworth, Kans.	3 miles above Leavenworth City.	Col. N. A. Miles, 5th Inf.	6	3d and 5th Inf.	
Fort Wallace, Kans.	2 miles from Wallace Station, on K. P. R. R.	Capt. L. T. Morris, 3d Inf.	2	6th Cav. and 3d Inf.	
Camp near Fort Hays, Kans.	Near Fort Hays	Lt.-Col. T. H. Neill, 6th Cav.	5	6th Cav.	
Southeastern Kansas.	At Fort Scott and vicinity	Capt. J. J. Upham, 6th Cav.	2	5th Inf.	
Fort Lyon, C. T.	On Arkansas River, 52 miles from Kit Carson.	Lt.-Col. J. R. Brooke, 3d Inf.	3	6th Cav. and 3d Inf.	

Military Division of the Missouri, &c.—Continued.

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1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

C.—Position and distribution of troops in the

POSTS.	SITUATIONS.	COMMANDING OFFICERS.	GARRISONS.		PRESENT.				
			Number of companies.	Regiments.	General officers.	Military secretary.	Aides-de-camp.	Adjutant-General's Dept.	Inspectors-general.
DEPARTMENT OF THE MISSOURI—Cont'd.									
Fort Garland, C. T.	On Utah Creek, 150 miles from Kit Carson.	Capt. H. Jewett, 15th Inf.	2	8th Cav. and 15th Inf.					
Camp Supply, I. T.	Near junction of Wolf and Beaver Creeks.	Lt.-Col. J. W. Davidson, 10th Cav.	6	6th and 10th Cav. and 3d Inf.					
Saint Louis depot	At Saint Louis	Col. E. Hatch, 9th Cav.		Detachment of recruits.					
Total			54		1	2	1	1	
DEPARTMENT OF TEXAS.									
Headquarters	San Antonio, Tex.	Brig.-Gen. C. C. Augur		Department staff.	1	3			
Austin, Tex.		Capt. E. E. Sellers, 10th Inf.	1	10th Inf.					
San Antonio, Tex.		Capt. N. Prime, 10th Inf.	2	10th and 25th Inf.					
Ringgold Barracks, Tex.	At Rio Grande City	Maj. T. M. Anderson, 10th Inf.	4	9th Cav. and 10th Inf.					
Fort Bliss, Tex.	Near Franklin	Capt. F. M. Cox, 25th Inf.	1	25th Inf.					
Fort Brown, Tex.	At Brownsville.	Lt.-Col. A. McD. McCook, 10th Inf.	6	4th Cav. and 10th Inf.					
Fort Clark, Tex.	On Las Moras River, 120 miles west of San Antonio.	Lt.-Col. Wesley Merritt, 9th Cav.	7	9th Cav. and 24th Inf.					
Fort Concho, Tex.	At the junction of the Main and North Conchos.	Major J. P. Hatch, 4th Cav.	6	4th Cav. and 11th Inf.					
Fort Davis, Tex.	On the Limpia River, 466 miles northwest of San Antonio.	Col. G. L. Andrews, 25th Inf.	3	9th Cav. and 25th Inf.					
Fort Duncan, Tex.	At Eagle Pass on the Rio Grande.	Maj. H. Merriam, 24th Inf.	3	9th Cav. and 24th Inf.					
Fort Griffin, Tex.	At Maxwell's Ranch	Col. Wm. H. Wood, 11th Inf.	5	4th Cav. and 11th Inf.					
Fort McIntosh, Tex.	At Laredo	Capt. C. N. W. Cunningham, 24th Inf.	2	9th Cav. and 24th Inf.					
Fort McKavett, Tex.	On San Saba River, 2 miles from its source.	Col. A. Doubleday, 24th Inf.	7	9th Cav. and 24th Inf.					
Fort Quitman, Tex.	On the Rio Grande, 80 miles below Franklin.	Capt. D. D. Van Valzah, 25th Inf.	2	25th Inf.					
Fort Richardson, Tex.	At Jacksborough.	Col. R. S. Mackenzie, 4th Cav.	10	4th Cav. and 11th Inf.					
Fort Stockton, Tex.	At Comanche Springs	Maj. Z. R. Bliss, 25th Inf.	3	9th Cav. and 25th Inf.					
Fort Gibson, I. T.	Near junction of Neosho and Arkansas Rivers.	Col. B. H. Grierson, 10th Cav.	4	10th Cav. & 25th Inf.					
Fort Sill, I. T.	At junction of Medicine Bluff and Cache Creeks.	Maj. G. W. Schofield, 10th Cav.	8	10th Cav.					
Total			74		1	3			
Total Military	Division of the Missouri.		242		5	13	4	2	

ADJUTANT-GENERAL'S OFFICE,
Washington, D. C., October 10, 1872.

Military Division of the Missouri, &c.—Continued.

PRESENT.																	ABSENT.							PRESENT AND ABSENT.					
Bureau of Military Justice.	Quartermaster's Department.	Subsistence Department.	Medical Department.	Pay Department.	Corps of Engineers.	Ordnance Department.	Post-chaplain.	Military store-keepers.	Colonels.	Lieutenant-colonels.	Majors.	Captains.	Regimental chaplains.	Regimental adjutants.	Regimental quartermasters.	Subalterns.	Enlisted men.	Total commissioned.	Aggregate.	General and staff officers.	Field and regimental staff officers.	Captains.	Subalterns.	Enlisted men.	Total commissioned.	Aggregate.	Commissioned officers.	Enlisted men.	Aggregate.
1	1	1	1	9	1	1	5	1	4	4	8	47	1	3	5	80	98	5	103	1	1	1	4	4	2	6	7	102	109
1	1	1	1	1	1	1	1	1	1	1	1	5	1	1	1	9	328	17	345	1	1	1	3	6	4	10	21	334	355
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	641	1	642	1	1	1	1	7	7	1	648	649	
1	6	3	1	9	1	1	5	1	4	4	8	47	1	3	5	80	3,944	198	4,142	1	4	7	27	73	39	112	237	4,017	4,254
1	2	1	1	6	1	2											9	15	24	1					1	1	16	9	25
												1				1	51	2	53			1			1	1	3	51	54
												2				4	112	6	118								6	112	118
			1							1		3				7	195	12	207				1	1	1	2	13	196	209
			1									1			2	57	3	60									3	57	60
			1				1	1				3	1	1	9	310	18	328		1	3	2	13	6	24	24	328	352	
			1									5	1	1	1	7	405	17	422		2	2	5	5	9	14	26	410	436
			1								2	3			9	341	17	358			3	2	7	5	12	22	348	370	
									1			3		1	1	5	224	11	235		1		1	2	2	4	13	226	239
			1							1		3			4	166	10	176				1	1	1	2	11	167	178	
			1									1	1	1	6	285	14	299			1	3	3	4	7	18	288	306	
												1			3	125	4	129			1	1	3	2	5	6	128	134	
			1									6	1	1	1	9	400	21	481			1	3	5	4	9	25	465	490
												2			3	113	5	118				1	3	1	4	6	116	122	
			1						1	1	2	7		1	11	623	24	647		2	3	7	7	12	19	36	630	666	
			1							1		3			5	162	10	172						13		13	10	175	185
			1									4	1	1	1	7	250	16	266		1		1	2	2	4	18	252	270
			1								2	8			9	276	21	297					6	2	6	8	27	278	305
1	6	1	1	6	1	3	2	6	3	9	59	59	3	6	7	101	4,164	226	4,390	1	7	14	35	72	57	129	283	4,236	4,519
3	24	10	49	23	4	2	11	52	17	27	200	320	23	336	14	756	790	15,546	5	14	39	119	292	177	469	967	15,048	16,015	

WM. D. WHIPPLE,
Assistant Adjutant-General.

ADJUTANT GENERAL'S OFFICE, 1872.

						TOTAL—		MILITARY ACAD- EMY.		Aggregate.
Artificers.	Saddlers.	Wagoners.	Privates—first class.	Privates—second class.	Privates.	Commissioned.	Enlisted.	Professors.	Cadets.	
						13				13
						15				15
						10				10
						70				70
						26				26
						163				163
						54				54
			135	92		103	282			385
			204	121		61	441			502
						1				1
						30				30
21	11	7			575	43	756			799
21	12	4			580	43	753			796
22	12	8			727	43	911			954
22	12	12			716	42	913			955
6	11	5			705	40	876			916
1	12	12			757	43	923			966
7	9	7			584	42	753			795
8	12	8			555	42	727			769
4	8	6			466	42	607			649
4	10	9			357	43	488			531
71	109	78			6,022	423	7,707			8,130
17		10			416	53	577			630
20		3			475	57	611			668
12		6			433	59	596			655
15		6			422	52	573			625
6		9			388	54	525			579
70		34			2,154	275	2,829			3,157
13		0			285	34	391			425
9		8			329	35	446			483
11		3			476	35	589			624
10		6			403	35	527			562
13		9			483	35	624			650
9		2			514	35	631			666
5		2			472	35	542			577
7		8			378	34	499			533
10		3			434	35	553			588
15		4			391	34	526			560
9		2			326	34	443			477
2		2			359	33	458			491
3					355	33	447			480
					418	35	524			559
10					411	35	505			540
15		7			370	33	500			533
7		6			357	34	462			496
13		5			346	35	460			465
3		6			371	34	488			522
3		2			381	34	499			533
6		4			392	33	480			522
15		3			405	34	520			554
5		7			382	33	498			531
9		6			404	32	588			620
		9			474	33	599			632
210	118				9,926	852	12,810			13,662
							116			116

REPORT
OF
THE ADJUTANT-GENERAL.

ADJUTANT-GENERAL'S OFFICE,
Washington, October 12, 1872.

SIR: The Adjutant-General being temporarily absent in consequence of injuries received, I have the honor to herewith transmit, for him, the annual report of this office.

I am, sir, very respectfully, your obedient servant,
WM. D. WHIPPLE,
Assistant Adjutant-General.

The Honorable the SECRETARY OF WAR.

E.—Position and distribution of troops in the Military Division of the Pacific, commanded by returns on file in the Adj

POSTS.	SITUATIONS.	COMMANDING OFFICERS.	GARRISONS.		PRESENT.				
			Number of companies.	Regiments.	General officers.	Military secretary.	Aides-de-camp.	Adjutant-General's Department.	Inspectors-general.
DEPARTMENT OF THE COLUMBIA.									
Headquarters.....	Portland, Oreg.....	Brig.-Gen. E. R. S. Canby		Staff of Division. Department staff.	1		2	1	1
Fort Vancouver, W. T.	18 miles north of Portland, Oreg.	Col. R. S. Granger, 21st Inf.	4	21st Inf.	1		2		1
Fort Colville, W. T.	35 miles south of dividing line between United States and British Columbia.	Capt. Evan Miles, 21st Inf.	1	21st Inf.					
Cape Disappointment, W. T.	At the mouth of the Columbia River.	1st Lt. J. C. Scantling, 2d Art.	1	2d Art.					
Fort Klamath, Oreg.	Near Lake Klamath.....	Maj. John Green, 1st Cav.	2	1st Cav. and 21st Inf.					
Fort Stevens, Oreg.	Near mouth of Columbia River.	Capt. A. C. M. Pennington, 2d Art.	1	2d Art.					
Fort Lapwai, I. T.	12 miles from Lewiston.	Capt. H. M. Smith, 21st Inf.	2	1st Cav. and 21st Inf.					
Fort Boise, I. T.	Near Boise City.....	Capt. G. M. Downey, 21st Inf.	1	21st Inf.					
Sitka, Alaska Ter.		Maj. H. A. Allen, 2d Art.	2	2d Art.					
Camp Warner, Oreg.	15 miles west of Warner Lake.	Lt.-Col. F. Wheaton, 21st Inf.	2	1st Cav. and 21st Inf.					
Camp Harney, Oreg.	60 miles south of Cañon City.	Maj. Elmer Otis, 1st Cav.	2	1st Cav. and 21st Inf.					
Total.....			18		1		2		1
DEPARTMENT OF ARIZONA.									
Headquarters.....	Prescott, A. T.....	Lt.-Col. George Crook, 23d Inf.		Department staff.			3		
Camp Apache, A. T.	In White Mountain country.	Maj. A. J. Dallas, 23d Inf.	3	1st Cav. and 23d Inf.					
Camp Mojave, A. T.	Near the head of Mojave Valley.	Capt. E. T. Thompson, 12th Inf.	1	12th Inf.					
Camp Beale's Springs, A. T.	43 miles west of Camp Mojave.	Capt. Thomas Byrne, 12th Inf.	1	12th Inf.					
Camp Bowie, A. T.	At Apache Pass.....	Capt. S. S. Sumner, 5th Cav.	2	5th Cav. and 23d Inf.					
Camp Crittenden, A. T.	56 miles southeast of Tucson.	2d Lt. William P. Hall, 5th Cav.	1	5th Cav.					
Camp Date Creek, A. T.	60 miles southwest of Prescott.	Capt. James Henton, 23d Inf.	2	5th Cav. and 23d Inf.					
Camp Grant, A. T.	56 miles north of Tucson.	Maj. W. B. Royall, 5th Cav.	4	5th Cav. and 23d Inf.					
Camp Hualpai, A. T.	40 miles northwest of Prescott.	Maj. E. W. Crittenden, 5th Cav.	2	5th Cav. and 23d Inf.					
Camp Lowell, A. T.	At Tucson.....	Capt. T. M. K. Smith, 23d Inf.	3	1st Cav. and 23d Inf.					
Camp McDowell, A. T.	52 miles north of Maricopa Wells.	Maj. E. A. Carr, 5th Cav.	5	5th Cav. and 23d Inf.					
Camp Verde, A. T.	38 miles from Prescott.	Capt. C. C. Carr, 1st Cav.	3	1st and 5th Cav. and 23d Inf.					
Fort Whipple, A. T.	Near Prescott.....	Capt. Thomas McGregor, 1st Cav.	2	1st Cav. and 23d Inf.					
Fort Yuma, Cal....	At junction of the Gila and Colorado Rivers.	Capt. A. B. MacGowan, 12th Inf.	1	12th Inf.					
Total.....			30				3		

Major-General J. M. Schofield, headquarters San Francisco, California, taken from the latest Adjutant-General's Office, 1872.

PRESENT.																	ABSENT.				PRESENT AND ABSENT.																																																							
Bureau of Military Justice.																	Quartermaster's Department.				Subintendence Department.		Medical Department.		Pay Department.		Corps of Engineers.		Ordnance Department.		Post-chaplain.		Military store-keeper.		Colonels.		Lieutenant-colonels.		Majors.		Captains.		Regimental chaplains.		Regimental adjutants.		Regimental quartermasters.		Subalterns.		Enlisted men.		Total commissioned.		Aggregate.		General and staff officers.		Field and regimental staff officers.		Captains.		Subalterns.		Enlisted men.		Total commissioned.		Aggregate.		Commissioned officers.		Enlisted men.		Aggregate.	
1	2	1	1	1	1	1	1	1	1	1	1	4	1	1	1	10	293	19	312	1	1	1	2	2	2	21	293	314																																																
2	1	2	3	1	1	1	1	1	1	1	1	1	1	1	1	1	53	3	56	1	1	1	2	1	3	4	55	59																																																
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	41	3	44	1	1	1	2	1	1	4	41	45																																																
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	102	5	107	1	1	1	2	2	4	7	104	111																																																
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	39	2	41	1	1	1	2	2	5	4	42	46																																																
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	161	6	107	1	1	1	4	4	6	105	111	111																																																
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	45	2	47	1	1	1	2	1	3	3	47	50																																																
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	117	8	125	1	1	1	2	1	3	9	119	128																																																
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	103	7	110	1	1	1	2	1	3	8	105	113																																																
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	110	6	116	1	1	1	6	1	7	7	116	123																																																
2	1	9	3	1	3	1	1	1	1	1	1	4	1	1	1	30	1,014	71	1,085	1	2	9	23	12	35	83	1,037	1,120																																																
4	1	4	1	1	1	1	1	1	1	1	1	1	1	1	1	24	14	38	1	1	1	4	1	5	10	24	38																																																	
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	6	167	9	176	1	1	1	4	1	5	10	171	181																																																
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	29	2	31	1	1	1	3	1	4	3	32	35																																																
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	51	3	54	1	1	1	1	1	1	3	52	55																																																
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	119	5	124	1	1	1	3	1	4	6	122	129																																																
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	47	1	48	1	1	1	2	3	3	48	51																																																	
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	106	3	109	1	1	1	6	2	8	5	112	117																																																
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	252	9	261	1	1	1	12	2	14	11	264	275																																																
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	111	6	117	1	1	1	1	1	1	7	111	118																																																
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4	183	5	188	2	2	3	4	7	9	186	195																																																	
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	6	366	15	381	1	1	3	8	4	12	10	374	393																																																
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4	160	7	173	1	2	11	3	14	10	177	187																																																	
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	110	4	114	1	1	2	1	2	3	6	111	117																																																
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	37	4	41	1	1	1	1	1	1	4	38	42																																																
4	3	4	1	1	1	1	1	1	1	1	1	5	2	2	2	41	1,768	87	1,855	1	7	15	54	23	77	110	1,822	1,932																																																

E.—Position and distribution of troops in the

POSTS.	SITUATIONS.	COMMANDING OFFICERS.	GARRISONS.		PRESENT.				
			Number of companies.	Regiments.	General officers.	Military secretary.	Aides-de-camp.	Adjutant-General's Dept.	Inspectors-general.
DEPARTMENT OF CALIFORNIA.									
Headquarters.....	San Francisco, Cal.....	Maj.-Gen. J. M. Schofield		Department staff.					1
Presidio, Cal.....		Lt.-Col. William H. French, 2d Art.	4	2d Art.....					
Point San José, Cal.....	In San Francisco Harbor	Capt. E. R. Platt, 2d Art.	1	2d Art.....					
Angel Island, Cal.....	do	Col. O. B. Willcox, 12th Inf.	1	12th Inf.....					
Alcatraz Island, Cal.....	do	Capt. J. M. Robertson, 2d Art.	2	2d Art.....					
Benicia Barracks, Cal.....	At Benicia.....	Col. A. C. Gillem, 1st Cav.		Headquarters 1st Cav.					
Camp Independence, Cal.....	On Oak Creek, in Owen's River Valley.	Capt. H. C. Egbert, 12th Inf.	1	12th Inf.....					
Camp Bidwell, Cal.....	At north end of Surprise Valley.	Capt. R. F. Bernard, 1st Cav.	1	1st Cav.....					
Camp Wright, Cal.....	In Round Valley, 203 miles north of San Francisco.	Capt. E. C. Woodruff, 12th Inf.	1	12th Inf.....					
Camp Gaston, Cal.....	Near junction of Trinity and Klamath Rivers.	Lt.-Col. A. D. Nelson, 12th Inf.	2	12th Inf.....					
Camp Halleck, Nev.....	12 miles south of Halleck station, on the Central Pacific Railroad.	Capt. James Biddle, 1st Cav.	2	1st Cav. and 12th Inf.					
Camp McDermitt, Nev.....	80 miles north of Winnemucca, on the Central Pacific Railroad.	Capt. Henry Wagner, 1st Cav.	1	1st Cav.....					
Fort Hall, I. T.....	140 miles north of Corinne, U. T., on the Union Pacific Railroad.	Capt. J. E. Putnam, 12th Inf.	1	12th Inf.....					
Total.....			17						1
Total Military Division of the Pacific			65		2	7	2	2	

ADJUTANT-GENERAL'S OFFICE,
Washington, D. C., October 10, 1872.

Military Division of the Pacific, &c.—Continued.

PRESENT.																ABSENT.						PRESENT AND ABSENT.																																																																																			
Bureau of Military Justice.																Quartermaster's Department.						Subsistence Department.			Medical Department.			Pay Department.			Corps of Engineers.			Ordnance Department.			Post-chaplain.			Military store-keeper.			Colonels.			Lieutenant-colonels.			Majors.			Captains.			Regimental chaplains.			Regimental adjutants.			Regimental quartermasters.			Subalterns.			Enlisted men.			Total commissioned.			Aggregate.			General and staff officers.			Field and regimental staff officers.			Captains.			Subalterns.			Enlisted men.			Total commissioned.			Aggregate.			Commissioned officers.			Enlisted men.			Aggregate.		
1	2	1	4	1	1	1	1	1	1	1	4	1	1	1	8	10	10	20	235	18	243	1	3	7	4	11	22	232	254	10	10	20																																																																									
		1									1	1	1	1	3	53	5	58	80				1	4	1	5	6	57	63																																																																												
			1								1	1	1	1	2	72	8	80					1	1	1	1	8	73	81																																																																												
				1								2			3	95	6	101					4	1	4	5	10	96	106																																																																												
					1									1	1	19	5	24	1						1	1	6	19	25																																																																												
			1								1				2	51	4	55									4	51	55																																																																												
											1				2	51	3	54						1		1	3	52	55																																																																												
												1			1	30	2	41					2		2	2	41	43																																																																													
					1								2		2	88	6	94				2	1	2	3	8	89	97																																																																													
											2				4	112	6	118					2		2	6	114	120																																																																													
											1				1	58	2	60					1	3	1	4	3	61	64																																																																												
											1				1	37	2	39					1	3	1	4	3	40	43																																																																												
1	2	6	4	1	3	2	3	2	17	3	3	3	3	29	910	77	987	2	19	25	14	39	91	935	1,026																																																																																
1	9	3	18	12	2	9	3	5	11	54	6	5	100	3,702	244	3,946	4	9	36	102	49	151	293	3,804	4,097																																																																																

WM. D. WHIPPLE,
Assistant Adjutant-General.

F.—Position and distribution of troops in the Department of the South, commanded by Brigadier-General in the Adjutant-General's Office.

POSTS.	SITUATIONS.	COMMANDING OFFICERS.	GARRISONS.	PRESENT.			
				Number of companies.	Regiments.	General officers.	Inspectors-general.
						Military secretary.	
						Aides-de-camp.	Adjutant-General's Dept.
Louisville, Ky		Col. S. D. Sturgis, 7th Cav.	Department staff.	1			
Frankfort, Ky		Col. F. F. Flint, 4th Inf.	7th Cav. and 4th & 16th Inf.	4			
Lexington, Ky		Maj. A. Chambers, 4th Inf.	4th Inf.	2			
Crab Orchard, Ky		Maj. J. G. Telford, 7th Cav.	4th Inf.	1			
Paducah, Ky		Capt. Wm. H. Powell, 4th Inf.	4th Inf.	1			
Mount Sterling, Ky		Capt. C. J. Von Herman, 4th Inf.	4th Inf.	1			
Elizabethtown, Ky		Lt.-Col. G. A. Custer, 7th Cav.	7th Cav. and 4th Inf.	2			
Lebanon, Ky		Lt.-Col. J. H. Potter, 4th Inf.	4th Inf.	2			
Shelbyville, Ky		Capt. W. W. Keogh, 7th Cav.	7th Cav.	1			
Newport Barracks, Ky	At Newport, Ky	Lt.-Col. A. V. Kautz, 15th Inf.	Detachment of recruits.				
Nashville, Tenn.		Lt.-Col. Jas. Van Voast, 16th Inf.	7th Cav. and 16th Inf.	3			
Humboldt, Tenn.		Capt. H. A. Theaker, 16th Inf.	16th Inf.	1			
Chattanooga, Tenn.		Capt. H. C. Cook, 2d Inf.	2d Inf.	2			
Huntsville, Ala.		Capt. W. F. Drum, 2d Inf.	2d Inf.	1			
Mobile, Ala.		Lt.-Col. T. C. English, 2d Inf.	2d Inf.	2			
Opelika, Ala.		Capt. T. B. Weir, 7th Cav.	7th Cav.	1			
Saint Augustine, Fla.		Capt. C. B. Layton, 16th Inf.	2d & 16th Inf.	3			
Savannah, Ga.		Capt. L. R. L. Livingston, 3d Art.	3d Art.	1			
Atlanta, Ga.		Maj. P. T. Swaine, 2d Inf.	2d & 16th Inf.	4			
Fort Pulaski, Ga.	On Cockspur Isl'd, mouth of Savannah River.	Capt. D. R. Ransom, 3d Art.	3d Art.	2			
Fort Macon, N. C.	On Bogue Island, in Beaufort Harbor.	Maj. Jos. Stewart, 4th Art.	4th Art.	2			
Fort Johnston, N. C.	At Smithville.	Capt. John Mendenhall, 4th Art.	4th Art.	1			
Raleigh, N. C.		Maj. C. H. Morgan, 4th Art.	4th Art.	2			
Rutherfordton, N. C.		Capt. H. C. Cushing, 4th Art.	4th Art.	1			
Lincolnton, N. C.		Capt. V. K. Hart, 7th Cav.	7th Cav.	1			
Charlotte, N. C.		Capt. E. Thomas, 4th Art.	4th Art.	1			
Charleston, S. C.		Col. G. W. Getty, 3d Art.	3d Art.	2			
Columbia, S. C.		Lt.-Col. H. M. Black, 18th Inf.	18th Inf.	3			
Chester, S. C.		Maj. W. H. Brown, 18th Inf.	18th Inf.	1			
Yorkville, S. C.		Maj. Lewis Merrill, 7th Cav.	7th Cav. and 18th Inf.	3			
Newberry, S. C.		Capt. Jas. Stewart, 18th Inf.	18th Inf.	1			
Unionville, S. C.		Capt. T. H. French, 7th Cav.	7th Cav.	2			
Spartanburgh, S. C.		Maj. M. A. Reno, 7th Cav.	7th Cav. and 2d Inf.	2			
Sumter, S. C.		Capt. T. J. Lloyd, 18th Inf.	18th Inf.	1			
Laurensville, S. C.		Capt. B. B. Keeler, 18th Inf.	7th Cav. and 18th Inf.	2			
Total Department of the South				60		1	3 1

ADJUTANT-GENERAL'S OFFICE,
Washington, D. C., October 10, 1872.

dier-General A. H. Terry, headquarters Louisville, Kentucky, taken from the latest returns on General's Office, 1872.

PRESENT.																	ABSENT.						PRESENT AND ABSENT.		

WM. D. WHIPPLE,
Assistant Adjutant-General.

G.—Position and distribution of troops in the Department of the Gulf, commanded by
from the latest returns on file in

POSTS.	SITUATIONS.	COMMANDING OFFICERS.	Number of companies.	GARRISONS.	PRESENT.				
				Regiments.	General officers.	Military secretary.	Aides-de-camp.	Adjutant-General's Dept.	Inspectors-general.
Jackson Barracks, La.	At New Orleans, La.	Lt.-Col. Alfred Sully, 19th Inf.	3	Department staff.					
Baton Rouge, La.		Col. C. H. Smith, 19th Inf.	5	19th Inf.			3		
Aberdeen, Miss.		Capt. T. E. Rose, 16th Inf.	1	16th Inf.					
Holly Springs, Miss.		Capt. C. W. Hotsenpiller, 19th Inf.	1	19th Inf.					
Jackson, Miss.		Maj. S. A. Wainwright, 16th Inf.	3	16th Inf.					
Meridian, Miss.		1st Lt. Adam Kramer, 6th Cav.	1	6th Cav.					
Oxford, Miss.		Capt. A. B. Chaffee, 6th Cav.	1	6th Cav.					
Key West, Fla.		Lt.-Col. R. B. Ayres, 3d Art.	2	3d Art.					
Fort Jefferson, Fla.	At the Garden Key, Tortugas.	1st Lt. A. G. Verplanck, 3d Art.	1	3d Art.					
Fort Barrancas, Fla.	In Pensacola Harbor.	Capt. Erskine Gittings, 3d Art.	3	3d Art.					
Little Rock, Ark.		Capt. H. E. Stansbury, 19th Inf.	1	19th Inf.					
Total Department of the Gulf.			22				3		

ADJUTANT-GENERAL'S OFFICE,
Washington, D. C., October 10, 1872.

Colonel William H. Emory, Fifth Cavalry, headquarters New Orleans, Louisiana, taken the Adjutant-General's Office, 1872.

PRESENT.																	ABSENT.					PRESENT AND ABSENT.									
Bureau of Military Justice. Quartermaster's Department. Subsistence Department. Medical Department. Pay Department. Corps of Engineers. Ordnance Department. Post-chaplain. Military store-keepers. Colonels. Lieutenant-colonels. Majors. Captains. Regimental chaplains. Regimental adjutants. Regimental quartermasters. Subalterns.																	Enlisted men. Total commissioned. Aggregate. General and staff officers. Field and regimental staff officers. Captains. Subalterns.					Enlisted men. Total commissioned. Aggregate. Commissioned officers. Enlisted men. Aggregate.									
1	1	1	1	2					1				2		5	7	6	13								6	7	13			
			1									1	1		4	149	8	157		1	1				1	2	3	10	156	160	
												1		1	4	246	12	258		2	4	1			2	7	9	19	248	267	
												1		1	1	53	2	55								3	2	56	58		
												1		1	1	39	2	41			1					1		1	3	39	42
												1		1	5	121	7	128		2					7	2	9	9	128	137	
														2	2	51	2	53		1					1	1	2	3	52	55	
												1		1	1	49	2	51			1				1	1	2	3	50	53	
														4	4	85	5	90			2	3			2	5	7	10	87	97	
														2	2	52	3	55		1	1				2		2	5	52	57	
												1		7	7	136	8	144			2	1			3		3	11	136	147	
												1		2	2	54	4	58							1		1	4	55	59	
1	1	4	2						2	2	1	9		1	3	1,042	61	1,103		2	13	9		18	24	42	85	1,060	1,145		

WM. D. WHIPPLE,
Assistant Adjutant-General.

Report of the recruiting service from October 1, 1871, to October 1, 1872

ADJUTANT-GENERAL'S OFFICE,
Washington, October 5, 1872.

In the principal northern and western cities rendezvous have been maintained with fair success for cavalry, artillery, and infantry.

The depots for artillery and infantry recruits remain as heretofore at Fort Columbus, New York Harbor, and Newport Barracks, Kentucky; and that for the cavalry service at Saint Louis depot, Missouri.

Recruiting for organizations on the Pacific coast is still kept up under the supervision of the commanding general, Military Division of the Pacific; but few men, however, are obtained, owing, it is supposed, to the great demand for labor in that section of the country.

In March, 1872, recruiting for the colored regiments of infantry was discontinued, those organizations having been filled to the authorized strength.

All recruiting officers, except those on the Pacific coast, recruit also for the colored regiments of cavalry.

In July, 1872, the standard of height for recruits was lowered to five feet four inches, it having been found impossible to otherwise supply the demand for recruits to keep the various organizations full.

WM. D. WHIPPLE,
Assistant Adjutant-General.

Statement showing the number of enlistments and re-enlistments in the Regular Army from October 1, 1871, to October 1, 1872; compiled from reports forwarded to this office by superintendents of the recruiting service, &c.

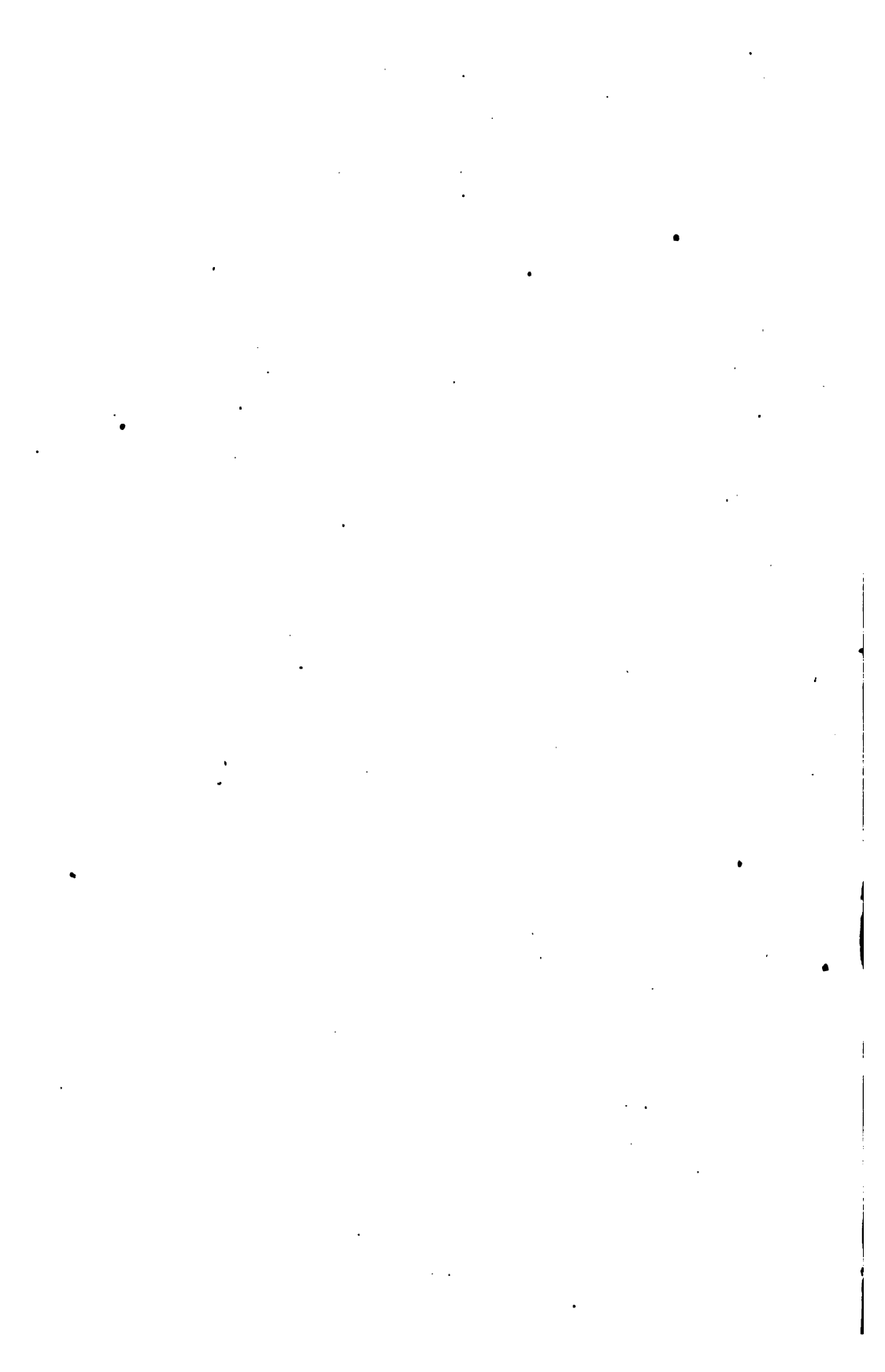
Regiments, &c.	Number en- listed and re-enlisted.	Regiments, &c.	Number en- listed and re-enlisted.	Regiments, &c.	Number en- listed and re-enlisted.
General service.....	5,457	Ninth Cavalry.....	95	Eleventh Infantry.....	36
Mounted service.....	3,476	Tenth Cavalry.....	80	Twelfth Infantry.....	75
Engineer Battalion.....	147	First Artillery.....	194	Thirteenth Infantry.....	22
Ordnance Department.....	236	Second Artillery.....	117	Fourteenth Infantry.....	21
Military Academy.....	46	Third Artillery.....	76	Fifteenth Infantry.....	54
Artillery School.....	2	Fourth Artillery.....	99	Sixteenth Infantry.....	121
Signal Corps.....	79	Fifth Artillery.....	66	Seventeenth Infantry.....	9
Ordnance-sergeants.....	13	First Infantry.....	198	Eighteenth Infantry.....	58
Hospital-stewards.....	30	Second Infantry.....	87	Nineteenth Infantry.....	134
First Cavalry.....	34	Third Infantry.....	101	Twentieth Infantry.....	46
Second Cavalry.....	78	Fourth Infantry.....	97	Twenty-first Infantry.....	65
Third Cavalry.....	25	Fifth Infantry.....	123	Twenty-second Infantry.....	16
Fourth Cavalry.....	19	Sixth Infantry.....	51	Twenty-third Infantry.....	75
Fifth Cavalry.....	22	Seventh Infantry.....	17	Twenty-fourth Infantry.....	26
Sixth Cavalry.....	69	Eighth Infantry.....	211	Twenty-fifth Infantry.....	31
Seventh Cavalry.....	136	Ninth Infantry.....	82		
Eighth Cavalry.....	70	Tenth Infantry.....	59	Total.....	12,391

NOTE.—Of the recruits enlisted for general service, 237 were for colored infantry; and of those for mounted service, 397 were for colored cavalry.

WM. D. WHIPPLE,
Assistant Adjutant-General.

ADJUTANT-GENERAL'S OFFICE,
Washington, October 5, 1872.

REPORT OF THE INSPECTOR-GENERAL.



R E P O R T
OF
THE INSPECTOR-GENERAL.

HEADQUARTERS ARMY OF THE UNITED STATES,
INSPECTOR-GENERAL'S OFFICE,
Washington City, October 10, 1872.

SIR: No changes have been made in the stations of the inspectors general or assistant inspectors-general of the army during the past year.

Under the act of Congress approved June 8, 1872, Lieutenant-Colonel Nelson H. Davis, assistant inspector-general, was appointed inspector-general, with the rank of colonel, and placed next to Colonel E. Schriver upon the list of inspectors-general.

The officers of this department, with the officers detailed as acting assistant inspectors-general at the headquarters of departments, have during the year been actively engaged in inspecting the numerous military posts and stations so widely dispersed over our extended domain, many of which are only accessible through unsettled territory, frequented by hostile Indians. Besides this, numerous inspections of damaged public property, with a view to its condemnation, have been made; irregularities and derelictions in duty have been examined into and reported upon, and various other matters not exclusively military, such as the investigation of claims, &c., have been intrusted to them, and it is believed these services have been satisfactorily performed.

The officers of the regular establishment have been employed during the year as follows, viz:

I was engaged, until the last of July, as president of a board convened by direction of the Secretary of War to prepare a system of general regulations, and a new code of Rules and Articles of War, for the administration of the affairs of the Army; also in devising a new uniform for the Army and preparing descriptions of the same. After which I proceeded to San Francisco, California, and made an inspection directed by the Secretary of War, under Special Orders No. 175, Adjutant General's Office, July 31, 1872.

Inspector-General D. B. Sacket has made thorough inspections of all the military posts occupied by troops of the line within the limits of the Military Division of the Atlantic. In August he was detailed as a member of the Army retiring board at Philadelphia, and has attended all its sessions since that time.

Inspector-General E. Schriver has been in charge of the inspector-general's office, at the headquarters of the Army, during my absence, the greater part of the year. He has also made special investigations and reports upon various important matters intrusted to him by the Secretary of War.

Inspector-General N. H. Davis has been occupied in making inspections, and performing the other duties of the inspection service, under the orders of the commander of the Department of the Missouri.

Inspector-General J. A. Hardie has been occupied with the customary duties of the inspection service, and with special services under orders of the Secretary of War and the Lieutenant-General, commanding the Military Division of the Missouri.

An elaborate report relating to Montana Indian war claims, with important papers relating thereto, was destroyed in the great conflagration at Chicago, and the replacement of these involved much time and labor. This was executed, approved by the Secretary of War, and submitted to Congress.

Assistant Inspector-General R. Jones has during the year inspected every military post in the Department of Arizona, and all in the Department of California, excepting Camps Gaston, Wright, and Independence; in the performance of which laborious services he was occupied one hundred and thirty-five days. This officer has also made many investigations and reports on other matters intrusted to him by the division commander, who indorsed upon his annual report the following: "Colonel Jones has discharged his duties with his customary strict fidelity, in the most satisfactory manner, and with marked benefit to the service."

Assistant Inspector-General A. Baird has during the year been engaged in making inspections and important investigations, under the orders of the Secretary of War and the commander of the Military Division of the South.

Assistant Inspector-General E. H. Ludington has during the year inspected every post in the Department of the Columbia, occupying one hundred and twenty-three days, and has rendered other valuable services in investigations, &c., under the direction of the commander of the Department of the Columbia.

The number of regular inspectors having been insufficient to meet the requirements of the inspection service during the year, one colonel, one major, and three captains have, from time to time, been detailed to act as inspectors.

The inspection reports for several years past have shown that the issues from the clothing remaining on hand after the rebellion, which, as a measure of economy, have been considered as unavoidable, have caused considerable dissatisfaction among the enlisted men, for the reason that this clothing is made from material inferior in quality, and cut so badly that the soldier has generally been obliged, at his own expense, to have his coat and trousers made over again.

I have no doubt that the existing system of fabricating the clothing, which has been practiced for a long time, has been zealously conducted by the officers of the Quartermaster's Department, but as we are about introducing a new uniform, it has occurred to me that this system might with benefit to the service be somewhat modified by selecting, for the permanent direction and control of the fabricating establishment, an officer of rank and experience, who has peculiar fitness for the position, and business qualifications. Such an officer, with no other duties to perform, would, it is believed, take pride in improving the condition of the establishment, and, by proper application and study, make himself familiar with the material, fabrication, and preservation of military clothing in all its branches.

Models of every article of the uniform, properly cut and made, as well as standard cloth and other materials, should be prepared and retained, and no clothing cut, made, or received that does not strictly conform to the criterion established. This can easily be accomplished when the material now on hand is consumed.

Colonel Hardie, in his annual report, says: "The new styles of uni-

form clothing are believed to be generally acceptable to the Army, but great interest is felt in the introduction of better material for clothing for enlisted men." Also, that "the law of March 15, 1872, with reference to the pay, &c., has already had a beneficial effect in promoting content among the enlisted men, and it is believed that it will materially lessen the number of desertions."

A uniform system of tactics for the cavalry would be highly advantageous to that arm of the service, and, in my judgment, an early adoption and promulgation of the new code of Army Regulations is greatly to be desired, and is anxiously looked for by the Army.

The Army Regulations of 1863, which, under the act of July 28, 1866, are to remain in force until new regulations are adopted, are not altogether adapted to the existing requirements of the service. Indeed, upon many military questions that frequently arise they are altogether silent, which leads to occasional discrepancies among officers regarding the interpretation of laws, regulations, and orders, and a corresponding want of uniformity in the methods of performing military duty at different places. It is believed that the new code of Regulations and Articles of War provide for the settlement of such doubtful military questions, and are adapted to almost any contingencies that are likely to arise. Moreover, they give ample and minute details upon the subject of calling out, mustering in and out, organizing, paying, &c., of volunteers and militia when called into the service.

The data for this have been deduced from extended service experience during the recent rebellion, and as none but very meager instructions upon this subject have ever been introduced into any previous edition of Army Regulations, the want of such a system as is contained in the new Regulations was seriously felt at the commencement of the late rebellion, and doubtless caused the unnecessary expenditure of a great deal of time and money.

The inspection reports during the year have been carefully examined in this office and extracts taken from them of all matters that it was deemed necessary to bring to the notice of the authorities at the headquarters of the Army, and these have been referred to the proper officers for their information and action.

The reports of the different inspectors show that through their recommendations and agency, sustained and enforced by their commanders, there has been continued improvement in the discipline, efficiency, and moral tone of the troops, as well as the promotion of a more discriminating and careful regard for the economical application of public money and property.

R. B. MARCY,

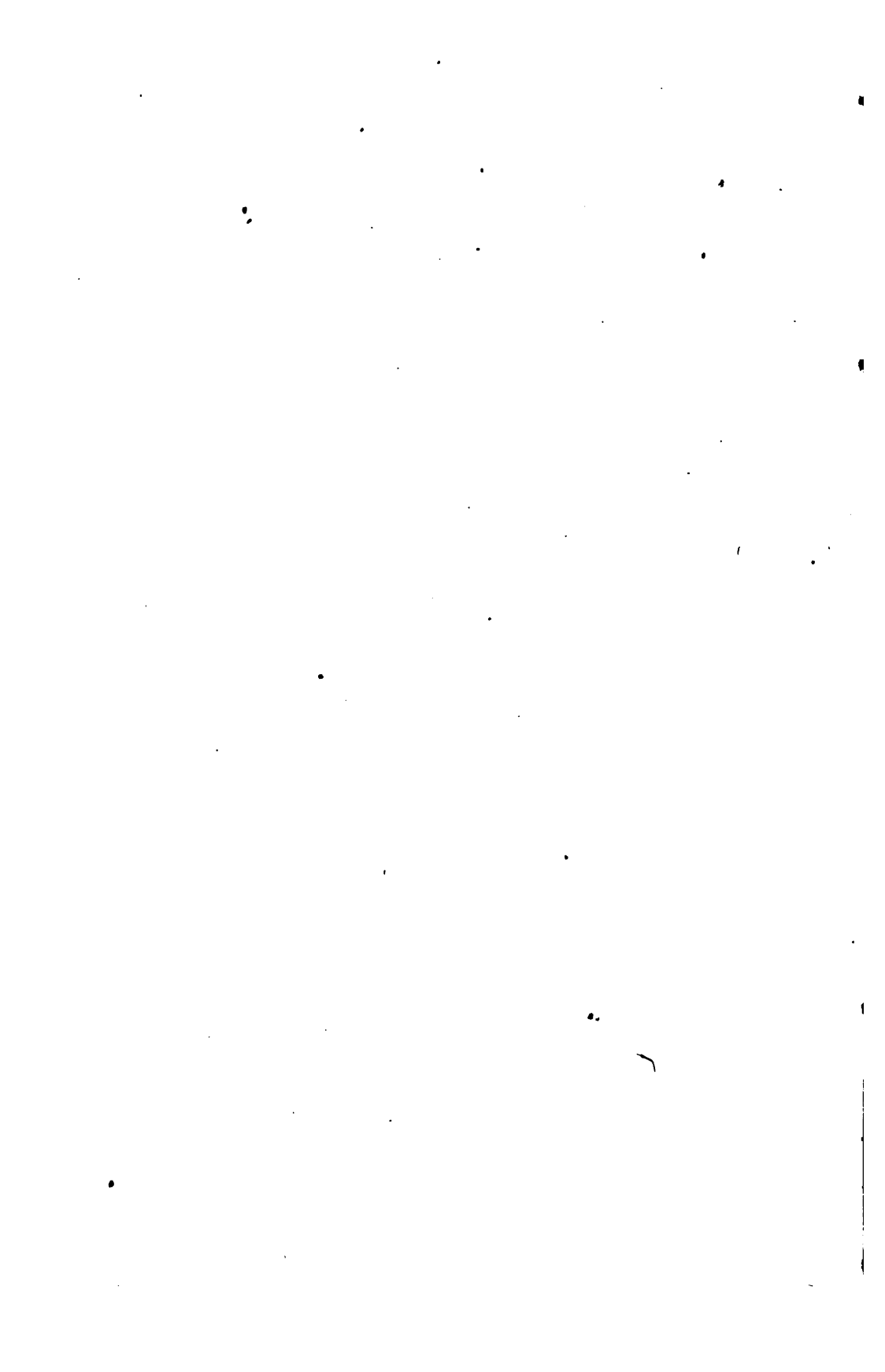
Inspector General, U. S. Army.

Brigadier-General E. D. TOWNSEND,

Adjutant-General, U. S. Army.



REPORT OF THE JUDGE-ADVOCATE-GENERAL.



REPORT
OF
THE JUDGE-ADVOCATE-GENERAL.

WAR DEPARTMENT,
Bureau of Military Justice, October 1, 1872.

SIR: I have the honor to submit for your consideration the following statement of the business of this Bureau since the date of my last annual report:

1. Number of records of military courts received, revised, and registered, 17,353.

2. Number of special reports made in regard to court-martial proceedings, upon applications for the remission of sentences, upon claims against the War Department, and upon the miscellaneous questions of law referred for the opinion of the Bureau, 1,112.

3. Abstracts of proceedings of trials furnished to the proper officials of the War and Treasury Departments, 1,495.

4. The copies of records furnished under the ninetieth Article of War to parties tried, have amounted to 7,088 pages.

It will be observed that the labors of the Bureau for the past year exceeded those of the year preceding by 5,159 records of military courts reviewed, 197 special reports, and 95 abstracts of proceedings of trials furnished.

The work of arranging, indexing, &c., the official papers of the late Provost-Marshal Baker, has progressed as rapidly as the limited clerical force of the Bureau would allow. Its completion within twelve months from the present date may be confidently anticipated.

The examination, in review, by this Bureau, of the records of trials occurring in the different military departments of the country, brings constantly before it what is felt to be a most serious defect in the administration of justice, and a positive injury to the service—namely, the inequality of sentences adjudged by different courts for identical offenses. Desertion, for instance, receives in one department a punishment of two, three, four, and even five years' confinement at hard labor; while, in another, a sentence providing for but one year's imprisonment is deemed an ample expiation, and this in cases which, from the trial-records, appear to be in all respects deserving of the same proportion of punishment. Prisoners thus differently treated are often brought together, when, by comparison, the injustice wrought is made manifest to the sufferers, and the result naturally is to harden rather than reform the culprits, one of the highest objects of punishment thus being made impossible of attainment.

Necessarily, large discretion must be reposed in courts-martial as to the measure of punishment required by the demands of justice, in a vast number of cases brought before them; yet the opinion is entertained that the service would be greatly benefited and its *morale* increased by the adoption of a code providing specific penalties for well-defined offenses,

with a *minimum* and *maximum* limitation to meet first offenses, and the cases of persistent offenders. By the pursuit of this plan it is believed the character of certainty of execution would attach to all sentences, adding largely to their corrective power, and relieving the Executive from the numerous applications for clemency which are now submitted.

The absence, too, of proper places of confinement for the enforcement of sentences, is pregnant with deplorable results. It has led to the designation of the different State penitentiaries by the War Department, through the sheer necessities of the case, as military prisons, to which prisoners guilty of purely military offenses are sent to associate with the vilest felons in the country, and subjected to all the humiliating and degrading discipline of those institutions. Many men who might under different treatment again become useful soldiers, are thus yearly added to the criminal classes by the stigma of infamy attached to them, and the demoralizing influence of their prison associations.

It is remarked upon the enforced use of these penitentiaries as military prisons, *eo nomine*, that while the letter of the law may not thereby be violated, its spirit most unquestionably is, as the legislative branch of the Government has indicated in the clearest manner its intention that soldiers guilty of purely military offenses should not be treated as felons.

The erection of prisons at small cost in different parts of the country, where prisoners might be placed wholly under military restraint, would not only, it is believed, save many good men to the service, but would, as well, be an absolute economy of expenditure.

I have pleasure in remarking upon the general efficiency, faithfulness, and zeal of the corps of judge-advocates, and of others associated with the Bureau in the performance of its multifarious duties.

J. HOLT,
Judge-Advocate-General.

The SECRETARY OF WAR.

REPORT OF THE QUARTERMASTER-GENERAL.



REPORT OF THE QUARTERMASTER-GENERAL.

QUARTERMASTER-GENERAL'S OFFICE,
Washington, D. C., October 10, 1872.

SIR: I have the honor to submit the annual report of operations of the Quartermaster's Department during the fiscal year ending June 30, 1872.

On July 1, 1871, the balance on account of appropriations for years prior to July 1, 1870, remaining to the credit of the Quartermaster's Department in the Treasury, undrawn, was, by report of last year.....	\$898,016 27
Amount placed to the credit of these appropriations by deposits, derived principally from sales, during the year, of public property purchased from appropriations of former years.....	2,467,633 61
Add sums which, having been expended by this Department, have been refunded by other Departments.....	215,879 51
	3,581,529 39
Requisitions on account of settlements made at the Treasury of claims and accounts.....	1,291,364 68
Balance to credit of appropriations for periods prior to July 1, 1870, remaining in Treasury on June 30, 1872.....	2,290,164 71

Balance of appropriations for year ending June 30, 1871.

Amount placed to the credit of appropriations by deposits, derived principally from sales during the year of public property purchased within the year ending June 30, 1871.....	\$333,493 91
Add sums which, having been expended by this Department, have been refunded by other Departments.....	12,223 47
	345,717 38
Requisitions on account of settlements made at the Treasury of claims and accounts.....	72,855 13
Balance to credit of appropriations for the year ending June 30, 1871, remaining in Treasury June 30, 1872.....	272,862 25

Appropriations for the fiscal year ending June 30, 1872.

Appropriation for fiscal year ending June 30, 1872, act of Congress approved March 3, 1871.....	\$11,055,000 00
Appropriation for deficiencies, act of Congress approved May 18, 1872..	1,450,000 00
Amount placed to the credit of appropriations by deposits, derived principally from sales during the year of public property purchased within the year ending June 30, 1872.....	110,804 46
Add sums which, having been expended by this Department, have been refunded by other Departments.....	1,000 30
	12,617,484 76

Remittance to officers for disbursement on requests of the Quartermaster-General.....	\$12,238,169 09	
Requisitions by the Secretary of War on requests of the Ordnance Department.....	20,800 00	
Requisitions on account of settlements made at the Treasury of claims and accounts	258,652 28	
		<u>\$12,517,621 37</u>
Balance of appropriations for the fiscal year ending June 30, 1872, remaining in the Treasury on June 30, 1872.....		<u>99,863 39</u>

The remittances on account of the appropriations for the fiscal year have been made upon estimates from the disbursing quartermasters, approved by their commanding officers, and have been distributed among the divisions, departments, and general depots, as follows :

To the Military Division of the Atlantic:		
Estimate chief quartermaster, headquarters.....	\$4,495 64	
Department of the East.....	288,029 92	
Department of the Lakes.....	103,549 92	
Total Division of the Atlantic.....		\$396,075 48
To the Military Division of the Missouri:		
Department of the Missouri.....	\$1,244,945 72	
Department of the Platte.....	748,841 94	
Department of Texas.....	1,636,959 65	
Department of Dakota.....	813,427 48	
District of New Mexico.....	577,349 02	
Depot of Saint Louis.....	324,356 71	
Depot of Chicago.....	285,726 88	
Total Division of the Missouri.....		5,631,607 40
To the Military Division of the Pacific.....		2,999,158 59
To the Department of the South.....		1,003,662 92
To the Department of the Gulf.....		197,290 56
To the principal depots:		
New York.....	\$497,060 56	
Philadelphia.....	652,566 96	
Washington.....	632,495 27	
Jeffersonville.....	136,670 47	
Total to principal depots.....		1,918,793 26
West Point.....	\$61,286 00	
National armory.....	3,266 96	
Columbus arsenal.....	1,149 10	
Indianapolis arsenal.....	1,236 69	
Watertown arsenal.....	12,613 10	
Alleghany arsenal.....	1,810 00	
Watervliet arsenal.....	2,539 40	
Frankford arsenal.....	900 00	
Augusta arsenal.....	2,246 50	
Benicia arsenal.....	2,814 78	
Detroit arsenal.....	607 61	
Rock Island arsenal.....	2,844 50	
Total to independent posts.....		93,314 64
Drawn on requests of the Ordnance Department.....		20,800 00
Amount of Treasury settlements.....		258,652 28
Total amount remitted.....		<u>12,519,355 13</u>
Deduct amount drawn from appropriation for Army contingencies included in above remittances.....		<u>1,733 76</u>
Total amount remitted from the appropriations of the Quartermaster's Department.....		<u><u>12,517,621 37</u></u>

At the close of the fiscal year some money remained in the hands of officers unexpended. Some officers had accounts for forage and necessary supplies, for transportation, and for other military service, presented to them in excess of the amounts available in their offices for their liquidation. The balances unexpended were called in, deposited in the Treasury, or transferred to officers who were deficient, and the accounts have been settled as far as possible; but there will probably, on final exhaustion of these floating balances, remain some accounts in excess of the specific appropriations, and it will probably be necessary to present to Congress an estimate for a deficiency on this account.

The rigid legislation of the last few years, changing the system of expenditure of the appropriation of the Quartermaster's Department, increases the complication of accounts and makes it more difficult to keep the expenditures within the specific appropriations. The floating balances in hands of officers must be larger when an officer is prohibited from using the surplus he may have on one appropriation to pay the bills chargeable under another. He must have, to comply with the law, at all times a working balance on account of every appropriation. Formerly, so long as he had any public funds of the Quartermaster's Department to his credit, he could meet any just demand. Now he may have \$100,000 to his credit in the public depository, but be unable to pay a bill for a ton of forage.

The annual estimates of this Department are based upon experience of the actual requirements of the service during past years. They are made out, under the present requirements of regulations, in the fall of one year, and attempt to declare, in anticipation, the wants of the military service for the whole of the year, which does not begin till ten months after they are presented, and which ends nearly two years after their presentation.

While the total gross average yearly expenditure in all branches of the service of the Quartermaster's Department can be estimated nearly, no one can pretend to accuracy in each and every item, or in each and every branch. It is true economy to allow the gross amount of the appropriations to be available, so that a saving in one branch, as in forage, may serve to provide for an unexpected or accidental increase of expenditure in another, as in transportation. One appropriation thus supplements another. But with the system lately adopted, in order that the service may be paid for, that those who sell to the Government their property or labor may be promptly paid, to keep intact the faith of the Government, it will be necessary to make a sufficient provision for each branch of the service, to be certain that no one shall be found insufficiently provided for at any time or place.

There are nine different heads of the regular appropriations of the Quartermaster's Department. Nine contingent balances are, therefore, to be appropriated, and each one of the hundreds of disbursing officers from Florida to Alaska, and from Maine to Arizona, needs to have working balances to his credit on several of these different accounts, for the use of the Quartermaster's Department alone. This requires so much of the funds of the Department to be distributed throughout the country, that at the close of the fiscal year there is liable to be found a considerable surplus to be returned to the Treasury by some officers, and a considerable deficiency of funds to pay the liabilities incurred by those in other districts.

The accounts and vouchers which have passed the administrative examination of this office, and have been transmitted to the Treasury for settlement since the last annual report, show disbursement—

From appropriations of years prior to June 30, 1871, amounting to....	\$35,256,492 42
In the fiscal year ending June 30, 1872.....	4,532,361 69
Total examined and sent to the Treasury	<u>39,788,854 11</u>

These disbursements are charged to appropriations as follows :

1. Appropriations for the Quartermaster's Department, viz :

Regular supplies.....	\$14,300,023 72
Incidental expenses.....	4,061,144 77
Purchase of cavalry and artillery horses.....	903,226 81
Barracks and quarters.....	6,633,339 40
Army transportation.....	11,712,509 35
Mileage; transportation of officers' baggage.....	549,711 68
Material for and amount expended in the purchase and preparation of clothing, camp and garrison equipage.....	727,558 25
Purchase of stoves.....	225,869 61
National cemeteries.....	597,811 56
	<u>\$39,711,195 15</u>

2. Special appropriations and expenditures for other Departments, viz :

Pay Department.....	\$14,061 22
Medical Department.....	5,589 40
Ordnance Department.....	1,361 47
Navy Department.....	440 31
Indian Department.....	34,842 55
Subsistence Department.....	381 51
Army contingencies.....	11,003 14
Military telegraphs.....	5,410 01
United States Military Academy.....	1,717 28
Recruiting service.....	55 15
Reconstruction service.....	1,642 90
Bureau of Refugees, Freedmen, and Abandoned Lands.....	1,069 62
Care, &c., of sick and disabled soldiers.....	84 40
	<u>77,658 96</u>

Total disbursements exhibited by the accounts examined during the year.....	<u>39,788,854 11</u>
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The work of the office in examination of accounts and returns is nearly up to date, for the first time since the great increase of the Army and of business attending the war threw upon it such a vast accumulation of accounts of money and reports of property. The only branch of its business which is not in a satisfactory condition is the examination of claims under the law of July 4, 1864. Too many of these claims remain on its files not finally acted on.

The Quartermaster's Department is charged with the duty of providing means of transportation by land and water for all troops and for all the material of war. It furnishes the horses for artillery and cavalry, and the horses and mules for the wagon-trains. It provides and distributes clothing, tents, camp and garrison equipage, forage, lumber, and all materials for camps, and for shelter of the troops and stores. It builds barracks, hospitals, and store-houses; provides wagons and ambulances, harness, except for cavalry and artillery horses; builds or chartered ships and steamers, docks and wharves; constructs and repairs roads, railways, and their bridges; clothes the Army, and is charged generally with the payment of all expenses of the movements and operations of the Army, not expressly assigned by law and regulation to any other Department. Arms, ammunition, medical and hospital

stores, and subsistence stores are purchased and issued by other Departments; but the Quartermaster's Department transports them all to the place of issue in camp, garrison, or in the field, and on the field of battle. These duties have been efficiently performed during the year.

The corps of quartermasters is not large enough to afford officers for the smaller military posts. The nature of our military service requires a great number of military posts, garrisoned each by a few companies, and the work of the Department at these posts is generally done by lieutenants of the line, detailed as acting assistant quartermasters. Their work is responsible and onerous. They incur responsibility for large quantities of property, and sometimes a heavy money responsibility, occasionally involving them in severe losses. For this duty they receive no special compensation beyond the pay of their lineal rank. Under these circumstances the duty is not desirable, and it is avoided rather than sought. The number of line officers who, during the fiscal year, have been on duty as acting assistant quartermasters, is reported at 380. Through their hands large amounts of public money pass. They are charged with operations in the erection of quarters, barracks, and store-houses, involving very heavy expenditures. They have charge of the stables and of the public animals, on whose condition depends the success of military operations, and that regularity of supply and transportation which is essential to the comfort, health, and efficiency of the troops. So important a duty should be sought, not imposed, and the allowance of some moderate sum to cover the responsibility, and compensate the officer for the losses to which he is exposed, such as is allowed to acting assistant commissaries, is very desirable. The difference in the cost of all military structures and in the length of service and condition of animals, wagons, and all materials of transportation, which would be made by the selection of the most intelligent and efficient business men among the lieutenants of the line for the duty of acting assistant quartermasters, would amply repay the small amount required to pay this allowance.

The average number of line officers on duty as acting assistant quartermasters during the past fiscal year was 175; the total number who so acted, 380, showing that they are frequently changed. The amount of an allowance of \$100 per year to each would be \$17,500. The amount to be saved by making the service desirable, one to be sought by intelligent officers, desirous of remaining on duty instead of being relieved from it, is many thousand dollars per annum.

The officers of the establishment are stationed at the principal purchasing and distributing centers, as purchasing and disbursing officers. They are not so numerous as economy requires, and two have resigned, two have died, and one has been cashiered since my last annual report was rendered, whose places, under the laws as they now stand, it is not possible to fill.

The interests of the military service require the removal of the restriction upon appointments to the Quartermaster's Department, and the Treasury would be benefited still more than the Army by its repeal.

EXAMINATION AND SETTLEMENT OF MONEY ACCOUNTS AND PROPERTY RETURNS.

Money-accounts.

Five thousand eight hundred and sixty money accounts were examined during the year. There remain in the office to be examined 3,427, of

which 2,242 are for disbursements in the year 1871, and 1,185 in the year 1872. All those of earlier date have been completed and sent to the Treasury.

Property-returns.

Nine thousand eight hundred and fifteen property-returns have been examined and sent to the Treasury since last annual report. There remain in the office 2,537, of which 1,716 relate to the year 1871, and 821 to the year 1872. All of earlier date have been examined and sent to the Treasury.

On the 27th of September, the number of money-accounts of dates prior to 1872, remaining in the office not examined, was reduced to 668, and of such property-returns to 1,056.

Until the issue of General Orders, No. 64, of October 25, 1871, only a partial examination of property-returns was required of this office, and they were transmitted to the Treasury, where the examination was completed. Since the issue of that order, of which a copy accompanies this report, a complete examination is made in this office, and they are not transmitted to the Treasury until all proper possible corrections have been made.

Notwithstanding the increase of work thrown upon this office, the system has worked well, and the arrears of work are now less than since the beginning of the war.

Under the act of June 23, 1870, to relieve officers from charges arising from unavoidable errors and accidental losses, 80 settlements have been made during the year. The total amount allowed in these special settlements is \$52,159.70.

The office loses from time to time the services of skillful and experienced clerks, who find promotion in other offices denied to them by the classification of the establishment of this one. The officer who has special charge of this branch of the office, recommends that the classification be modified to allow the same number of clerks as now, but classified as follows: One of class four, twelve of class three, sixteen of class two, and twenty-seven of class one. Believing that this would increase the efficiency of the office, I ask that it be recommended by you to Congress.

PUBLIC ANIMALS.

The whole appropriation for purchase of cavalry and artillery horses has been expended, and the reports show the purchase of 3,277 horses. Prices have varied from \$199.37, paid for 15 horses purchased at Washington, to \$102.92, the average cost of 707 purchased in Texas.

Two hundred and nine mules have been purchased for the trains. Of some purchases made in Dakota reports have not yet been received, so that the full number of animals bought will somewhat exceed the above numbers.

SALES.

One thousand and ninety-five horses have been sold for \$47,587.77, 413 mules for \$18,233.90, and 4 oxen for \$347.66. The proceeds of these sales have been paid into the Treasury of the United States.

• Three hundred and seventy-one horses, 520 mules, and 5 oxen have died, and 187 horses and 340 mules have been lost or stolen during the year.

The total number reported in service on 30th June, is 9,729 horses,

8,758 mules, and 117 oxen. It appears, therefore, that one-third of the cavalry horses require to be replaced yearly.

SUPPLIES.

The annual estimates or requisitions for supplies to the military posts are examined in this office, in order to correct them when unnecessarily large, and to supply from the general depots such articles as are still on hand therein, principally the stock collected in those depots at the close of the war. Perishable articles of consumption are obtained by contract, under the direction of the chief quartermasters of divisions and departments.

CONTRACTS.

Six hundred and thirty-two contracts have been filed during the year. Among these are: for forage 243 for 23,626,032 pounds of oats and barley, 31,012,240 pounds of corn, and 53,042 tons of hay. There have been filed 20 contracts for coal, for 18,117 tons, and 3 for coal, quantities to be as needed; 114 contracts for 99,664 cords of wood, and 22 for wood, quantities not stated, but as needed; 34 for charcoal, for 43,725 bushels; 23 for building-materials; 9 for repairs and construction of buildings; 37 for transportation; 12 for 1,961 cavalry and 75 artillery horses, and 241 mules; 14 for clothing, camp and garrison equipage; 20 for work on national cemeteries, and 23 leases.

FORAGE, STRAW, AND FUEL.

The issues during the year have been—of corn, 701,244 bushels; oats, 886,127 bushels; barley, 170,806 bushels; hay, 54,840 tons; straw, 3,839 tons; wood, 115,995 cords; anthracite coal, 17,102 tons; bituminous coal, 11,042 tons.

HORSESHOEING.

A book with thirty-three illustrations describing and explaining the Dunbar system of horseshoeing, in which the farriers of the Army were instructed, by direction of Congress, having been prepared by Mr. John Kiernan, farrier in the service of the department, submitted to a board of officers, and by them recommended for distribution to the Army, has been published by your authority. Copies have been sent to each mounted company, and to each quartermaster in service. The book will preserve an excellent method of shoeing from falling out of use. A few copies remain for future distribution.

CLOTHING AND EQUIPAGE.

The Army has been supplied with clothing and equipage during the past fiscal year in great measure from the stock on hand at the close of the war. This has suffered from long storage, notwithstanding all efforts to preserve it. Moth will penetrate the most ingeniously contrived defenses, and leather, and shoes, and knapsacks, and all painted cloths suffer from chemical reactions among their perishable ingredients.

The clothing is principally collected into two arsenals or depots—one at Philadelphia, the Schuylkill arsenal; the other at Jeffersonville, Indiana, on the Ohio River.

At the Schuylkill arsenal a good masonry fire-proof warehouse affords

facilities for the preservation of the property. At Jeffersonville a warehouse, also fire-proof, is nearly completed, to which the stock, heretofore kept in temporary wooden warehouses, relics of the campaigns in the West, is being transferred.

At Jeffersonville, at a sale at public auction in September, 1871, goods to the value, as determined by the auction offers, of \$1,291,830.16, were disposed of. Of this sum, \$1,266,830.16 has been turned into the Treasury. The remaining \$25,000 is the value of an invoice of clothing bid off at auction by merchants, who were allowed to transfer this portion of the purchase to the National Asylum for Disabled Soldiers, substituting that asylum for themselves. The accounts for this \$25,000 have been duly presented, but thus far I am not advised of their payment into the Treasury.

Sales made at Philadelphia from the Schuylkill arsenal produced the sum of \$510,423.17. Other small sales of materials and of clothing to officers of the Army for their personal outfit, and some sales to persons organizing under State laws as uniformed militia or volunteers, carry the total of the account of sales of clothing and equipage during the year to \$1,861,373.63, of which \$1,843,831.40 have already been deposited in the Treasury under the law. There is a great loss in these sales. The original cost to the United States of the old clothing sold during the year was probably over \$10,000,000. It was purchased at war prices, toward the close of the war, but it had been exposed in transfer from camp to camp, or from warehouse to warehouse. Some of it was of inferior material when purchased. It was impossible to maintain during the pressure of the war-demand the highest standard of quality in all cases. When one contractor failed, it was necessary to make contracts or purchases from another of the best material obtainable, or see the Army of the Republic suffer in face of the enemy for want of sufficient clothing. The sales made have been principally of this originally inferior material, or of wool which the moths have attacked and injured, and of leather which time has injured. The appropriations for this branch of the Army service for the fiscal year have been \$650,000. The expenditures during the year, including \$17,542.23 received by various officers from sales, and used in the purchase of clothing and equipage, have amounted to \$667,529.63. The amount turned into the Treasury by the Quartermaster's Department on this account during the year being \$1,843,831.40, exceeds the expenditures for clothing and equipage of the Army for the year by \$1,176,302.37.

The old knapsacks, made of painted cloth, having become generally unfit for use by chemical decomposition, which rendered the black paint with which they were covered soft and sticky, I recommended that in commencing the manufacture of a new equipment for the Army, the whole equipment should be revised. After study, and discussion, and comparison of models, you determined to adopt, provisionally, the style of equipment recently adopted in the British army after many years of trial and experiment. As this required the manufacture of belts, cartridge-pouches, and knapsacks and haversacks on entirely new patterns, I advised that the whole equipment be made under one department; and as the Ordnance Department has had the charge heretofore of making the larger part of the leather equipment of the soldier, that the manufacture of the complete equipment, including knapsacks haversacks, and canteens, should be transferred to that Department. This met the approbation of the General of the Army and of yourself, and the transfer was ordered by General Orders No. 75, of December 26, 1871, of which a copy for record accompanies this report. Such articles

of the old equipment in possession of this office as were serviceable, and \$20,800 of the appropriation for clothing and equipage, were transferred to the Ordnance Department under this arrangement.

The sum of \$41,953 from the present fiscal year's appropriation for clothing and equipage will also be transferred to the Ordnance Department, these being the sums which had been appropriated by Congress upon estimates of this office.

Among the articles transferred were 1,844 dressed seal-skins, which had been purchased in Alaska, and dressed in California for the purpose of manufacture into knapsacks, before the change was determined on.

Congress having appropriated money specially for preservation of clothing and equipage from moth and mildew, and it being understood that the process of George A. Cowles & Co. was specially intended, and that appearing from experiments reported in the Army to be the one giving most promise of success, a considerable sum has been expended in the preparation of great-coats, uniform-coats, blouses, trousers, and materials by this process. I am not, as yet, fully convinced that the result will be absolute safety. The first reports were generally very favorable as to the prevention of moth and mildew, but quite recently observations have been reported of ravages of moths in articles believed to have been prepared by this firm. It is not, however, yet absolutely certain that the articles injured were not of those subjected to some of the other processes which have been tried.

Considering the large quantity of woolen material which is now in store, and its great value, I have directed that some of it be placed in a close vessel and the air exhausted by pumps. No living animal can survive long the absolute deprivation of air, and if this deprivation of air will also destroy the vitality of the egg, this process, supplemented perhaps by the introduction of carbonic acid gas into the receiver when first opened, will be a cheap method of treatment of cloths and clothing in bales and boxes, destroying the moths without the expense of breaking open and handling the separate articles. Carbonic acid is not only a non-supporter of life, but acts as a poison. I have hopes that by fitting up proper machinery and apparatus at the arsenal, I may be able to put an end, at a cheap rate, to the ravages of the moth.

As a vacuum is also a powerful desiccator, this process, which is not expensive, might probably be applied with advantage to grain and breadstuffs intended for storage, or for shipment on long voyages. Moisture evaporates rapidly when the articles containing it are relieved from atmospheric pressure, and the weevil and other vermin will be destroyed by being deprived of air.

During the past year an improvement in the shoes and boots of the Army has been made by the adoption, as a standard, of those in which the sole is secured to the upper leather by screwed brass wire, instead of wooden pegs or linen thread. Those issued and tried in service have given great satisfaction.

A new standard blanket has also been adopted for the Army. It is of better material and better workmanship than has ever before been furnished to the troops. The old stock having been finally exhausted, advantage has been taken of the opportunity to improve the standard. The new one adopted as the standard was made at the Mission Mills, San Francisco, California, justly noted for the excellence of their manufactures. The army on the Pacific coast is being supplied with the manufacture of these mills. The contract to make a similar blanket in the East has been awarded, on public competition at the Schuylkill arsenal, to Seville Scofield. This blanket costs more than the old one,

but it is warmer, softer, and will be more durable than any heretofore issued.

A change in the uniform of the Army has been ordered. This will increase the expenditures for the present fiscal year by the making up of complete outfit for the troops, not anticipated when the appropriations were made by Congress. Efforts are being made to distribute the new uniform by the 1st December. Most of the material needed is in the arsenals. The principal expense will be the making up of the garments, and the purchase of facings and trimmings. A new and better standard stocking has also been adopted.

But few claims on account of clothing and equipage, under the law of 4th July, 1864, are presented. Seven only, amounting to \$8,567 65, have been received and disposed of during the year.

The examination of returns of clothing and equipage, though made more complete under your General Orders No. 7 of 1872, than under former practice, has been kept up to date, and in this branch of the business of the office there are no arrears.

Statements of the quantity of clothing and equipage on hand, distributed, sold, lost, and destroyed, and of the proceeds of such sales, and of the expenditures and receipts of the Department on this account, accompany the report of Major J. D. Bingham, quartermaster, who has during the past year had charge of this branch of the office, and also of the settlement of accounts, and of the business in this office relating to the national cemeteries. His detailed reports on these several subjects are herewith.

IRON BUNKS.

During the year 8,666 iron bunks were distributed to the troops, which give great satisfaction. They give each soldier a separate and distinct bed, and conduce both to comfort and health, and are a great improvement upon the rough wooden two-story bunks heretofore in general use at military posts. The contract for the ensuing year has been awarded to the Composite Iron Company, their bunk being the best. The price is \$5, which is the same as last year's price for this bunk.

TRANSPORTATION.

The Quartermaster's Department has transported during the year 54,068 persons, 4,011 animals, principally horses and mules, and 123,083,701 pounds of material.

The regulations concerning transportation of this Department have been the growth of many years, during which they have undergone many modifications by general or special orders and instructions. No single book can now be referred to containing them all in a compact form. The whole have, during the fiscal year, been revised and modified in this office, and transmitted to the Second Comptroller, whose duty it is, under the act of 3d March, 1817, to report to the Secretary of War the official forms for disbursing the appropriations of the Army, and for stating the accounts of its officers. When returned they will be submitted to you for action. Some concise collection of these rules or customs of service is much needed for constant reference and consultation, even of officers of experience, and still more for the instruction of young officers entering for the first time upon duties as acting assistant quartermasters.

Railroad transportation.

Number of persons moved by railroad, 24,567; number of animals moved by railroad, 3,636; freight, 52,850,235 pounds, or 26,000 tons.

So far as yet reported, disbursing officers of the Quartermaster's Department, at various points, have paid, during the year, on account of railroad service, \$411,599.08, and in this office there have been examined and transmitted to the Treasury, for settlement and payment, accounts for railroad service to the amount of \$1,157,764.72; making a total expended by officers, and referred for settlement through the Treasury for railroad transportation, \$1,569,363.80, of which amount the sum of about \$1,300,000 was on account of service for the fiscal year.

The movement over the Pacific Railroads has been:

	Persons.	Material in pounds.
Union Pacific Railroad.....	3, 645	14, 501, 918
Central Pacific, of California.....	1, 493	5, 111, 980
Kansas Pacific.....	3, 939	16, 858, 340
Sioux City and Pacific.....	243	1, 155, 306
Total on Pacific Railroads.....	9, 320	37, 627, 544

or 18,813 tons.

The earnings of the Pacific Railroads, settled during the year, by payment of 50 per cent. in cash at the Treasury, and the retention and application of 50 per cent. to the repayment of interest on the bonds of the United States issued to these railroads, amount to:

Union Pacific Railroad Company.....	\$399, 193 72
Kansas Pacific Railroad Company.....	166, 113 20
Central Pacific Railroad Company.....	229, 111 75
Western Pacific Railroad Company.....	64 50
Sioux City and Pacific Railroad Company.....	6, 373 83

Total..... 800, 857 00

Last year the settlements with these roads aggregated..... \$767, 047 99

A table of land-grant railroads, believed to be complete, has, with much difficulty and after long research, been compiled and printed. A copy accompanies this report.

Congress has granted lands to various companies upon various conditions. Some of the grants are on condition that the railroads shall remain public highways for the use of the Government of the United States, free from toll or other charges upon the transportation of any property or troops of the United States. In settling with these roads 33½ per cent. is deducted from the ordinary freight tariff rates; in other cases the condition of the grant is such that the property and troops of the United States are to be at all times transported over the roads at the cost, charges, and expense of the companies owning or operating them. To these roads no payments are made for transportation.

Wagon and stage transportation.

Number of passengers, 2,391; pounds of freight, 27,682,352, or 13,841 tons. The cost, so far as reported, has been \$1,127,801.88, of which all but \$77,021.12 has been paid by disbursing officers of this Department. The latter sum was settled through the accounting officers of the Treasury, on reference from this office.

The service is performed under contracts with the chief quartermasters of the various military divisions and departments, made under the supervision of department and division commanders. Some of the more important contracts are submitted before conclusion, for consideration of the Secretary of War.

The rates of land transportation have not changed materially since last annual report. On Route No. 2, from points on the railroads to any points in the State of Kansas and Territories of Colorado, New Mexico and Arizona, and to such points of the Indian Territory and State of Texas as are north of the Red River and west of the ninety-seventh meridian, the price has been reduced from \$1.21 to \$1.17½ per 100 pounds per 100 miles. On Route No. 4, in Minnesota and Dakota, the price has been reduced from \$1.27 to \$1.23. In Montana, from \$1.57½ to \$1.05.

The rates for supplying Fort Sill, Indian Territory, and Forts Richardson and Griffin, Texas, from Saint Louis, have increased. In 1870-'71 the rates were, to Fort Sill, \$3.70; Fort Richardson, \$4.70; Fort Griffin, \$5.70. In 1871-'72 they have been \$3.93, \$5.72, and \$6.82, respectively.

The expenditure for stage transportation during the year was \$48,975.84.

Water transportation.

Four schooners, one sloop, one sail-boat, two flat-boats, eleven steamers, one propeller, and one barge have been under charter as transports at a cost of \$34,014.02.

One steam-launch, one flat-boat, one barge, one propeller, and two schooners, owned by the United States, have been employed at a cost of \$35,259.01.

The total movement by water has been 27,110 persons, 375 animals, and 42,551,114 pounds, or 21,275 tons of freight, at a cost of \$626,373.52.

A steam-launch, 50 feet long, 12 feet beam, and 4 feet deep, with a cylinder of 10-inch diameter and 10-inch stroke, was built by Messrs. Pusey, Jones & Co., of Wilmington, Delaware, for the Department, to be used as a tender and transport for Fort Pulaski, Savannah River. Her purchase is included in the above. She keeps up the communication between the fort and the city, transports mails, passengers, and provisions, and tows a barge loaded with stores. Her ordinary speed is, with the tide, 11.47 miles, against the tide, 6 miles per hour. She cost \$7,000, and the expense of running her is \$137 per month. Her usefulness in keeping up communication, saving the wear and tear of life of soldiers, formerly exposed in a row-boat to severe toil under a hot sun, in a most malarious region, is very great. There are other military posts at which similar boats would be very useful.

For transportation by water in the Division of the Pacific during the year, officers have paid \$361,088.89. For steamboat transportation in the Division of the Missouri they have paid \$156,810.25, most of which was paid under contract for movement of troops and supplies between Sioux City and points on the Upper Missouri. About one-fourth of the above was paid for service at other points on the Western rivers in the Division of the Missouri. In the Division of the Atlantic there has been paid for transportation by water \$58,215.37.

Recapitulation of expenditures during fiscal year on account of transportation.

Amount paid on account of railroad transportation.....	\$1,300,000 00
Amount paid on account of water transportation.....	626,373 52

Amount paid on account of stage transportation.....	\$48,975 84
Amount paid on account of wagon transportation.....	1,100,000 00
Amount paid on account of purchase of transportation animals, purchase and repair of army and spring wagons, and carts, harness, &c., hire of teamsters, wharfage, tolls, &c.....	924,650 64
Amount of appropriation.....	<u>4,000,000 00</u>

MOVEMENTS OF TROOPS.

The principal movements of troops during the year have been the transfer of the Eighth Infantry from the sea-board at New York to the Departments of the Platte and Dakota in the valleys of the Mississippi and Missouri; of the Sixth Infantry from the Department of the Missouri to that of Dakota; of the Twenty-first Infantry from Arizona to the Department of Columbia, exchanging stations with the Twenty-third, which moved from the Columbia to the Colorado and Gila; of the Fifth Cavalry from the Department of the Platte to Arizona; and of the third from Arizona to occupy the stations in the Department of the Platte vacated by the Fifth. Many other local changes of station have been carried out during the year, but these were the most considerable.

MILITARY BUILDINGS.

Barracks and quarters.

During the year ninety-five new buildings have been authorized. They include barracks, officers' quarters, stables, store-houses, guard-houses, &c. They are at military posts in fourteen States, viz: Maine, New York, Maryland, Virginia, North Carolina, South Carolina, Kentucky, Tennessee, Louisiana, Texas, Illinois, Kansas, Nebraska, and California; and in seven Territories, viz: Colorado, Dakota, Montana, New Mexico, Utah, Arizona, and the Indian Territory. Their estimated cost was \$240,853.

Wharves.

Authority was given for construction and repair of wharves to the amount of \$14,903.

Repairs.

Upon special estimates submitted to the Secretary of War authority has been given to make repairs, alterations, &c., of public buildings at the various military posts to the amount of \$92,948. These expenditures, under these special authorizations, were distributed as follows:

Department of the Missouri.....	\$58,119 00
Department of the Platte	10,350 00
Department of Dakota	111,450 00
Department of the East.....	78,898 00
Department of the Lakes	200 00
Department of the South	29,486 00
Department of Texas.....	68,060 00
Department of the Gulf.....	19,162 00
Department of California.....	5,200 00
Department of Arizona	3,000 00
Department of Columbia	2,000 00
	<u>385,925 00</u>

The whole appropriation for barracks and quarters has been expended during the year. Current small repairs at the military posts, and con-

struction of huts at camps taken up temporarily in the exigencies of military service, with rents, hire of mechanics, and other incidental expenses attending the care and preservation of several thousand buildings occupied by the Army, absorb a large part of the appropriation whose application has not yet been analyzed in detail.

New posts.

On 13th February, 1872, the Lieutenant-General commanding Military Division of the Missouri, was authorized to establish a new post for four or five companies near Beaver City, Utah, and application was made to Congress on 6th May, 1872, for a special appropriation of \$120,000 to erect the necessary buildings. No appropriation was made by Congress.

On the 6th April, 1872, the establishment of a new post for two companies, at or near the crossing of the Missouri River by the Northern Pacific Railroad, was authorized and is now under construction. At the same time orders were given to make Fort Buford, in course of construction, a six instead of a ten company post.

Since the close of the fiscal year the construction of two new posts in Arizona, one at or near Tucson, and one near the mouth of the San Carlos River, has been authorized. These posts are for four companies each, and to them the troops are to be removed from Camp Crittenden and from Camp Grant, a very unhealthy locality, with old and worn-out huts.

Other new posts have been authorized, since the close of the fiscal year, at Otter Crossing, James River, crossing of the Northern Pacific Railroad, and Camp Tularosa; also extensive reconstruction at Fort Bayard, New Mexico; Fort Clark, Texas; Camp Douglas, Utah; Camp Independence, California, destroyed by an earthquake; and at Camp Supply, Indian Territory. The estimates for most of these works were larger than the amount which, with the appropriation, could be supplied, and the expenditures authorized have been limited in accordance with the appropriation law.

Buildings sold.

Fifty-three buildings have been sold during the year, upon authority of the Secretary of War.

Property given up.

Under the act of 2d May, 1872, the wharf property in the city of New Orleans has been relinquished and transferred to the city authorities.

Hospital buildings.

Construction, repairs, and alteration of hospital buildings during the year have been authorized by the Secretary of War, as follows: Fort Concho, Texas, \$350; Fort McKavitt, Texas, \$13,000; Savannah, Georgia, \$3,888; Fort Sill, Indian Territory, \$10,000; Fort Stanton, New Mexico, \$500; Fort Reynolds, Colorado Territory, \$890.37; Lebanon, Kentucky, \$175; Fort Riley, Kansas, \$1,213.25; Raleigh, North Carolina, \$202.67; Fort Adams, Rhode Island, \$318.26; Nashville, Tennessee, \$501; Chicago, Illinois, \$160; Fort Hamilton, New York Harbor, \$178.80; Fort Foote, Maryland, \$83.25; Fort Washington, Mary-

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and, \$465; Fort Whipple, Virginia, \$450; Fort Wadsworth, New York Harbor, \$1,075; Fort Davis, Texas, \$277.25; Jackson Barracks, Louisiana, \$1,006.52; Fort Riley, Kansas, \$2,614.59; Fort Johnson, North Carolina, \$171.62; total, \$37,520.58.

Jeffersonville depot.

The work of construction of fire-proof warehouses for storage of Government property at Jeffersonville, Indiana, is to be completed by the middle of October. These warehouses have been arranged in the form of a hollow square, located upon ground given to the United States for the purpose by the city of Jeffersonville. They are of brick, one story high, except the office-room, which is placed over the main entrance.

The building is 52 feet 8 inches wide, and surrounds a court-yard which is 696 feet square. The exterior and interior fronts are alike, except in extent, the interior fronts being each 696 feet, and the exterior 801 feet 4 inches in length.

The architecture is plain, consisting of arches and piers, with pilasters of the Tuscan order, all executed in brick-work. The roof is of slate. The floor is paved with brick, grouted with cement, so as to be proof against vermin.

There are no openings, doors, or windows in the exterior wall, except in the center of one of the fronts where the entrance to the court-yard is placed, and over which is the office. At this entrance provision will be made for the entrance of railroad cars, as well as of Army wagons.

The building is divided by brick fire-walls into rooms of about 68 by 50 feet. These fire-walls go through the roof, and in case of fire originating among the stores in any one warehouse, would prevent its communication to those adjoining.

The arches in the outer walls are blind arches closed with brick-work. Those in the interior walls facing the court-yard are closed by hinged doors, to be opened at will for light, ventilation, and communication.

As a precaution against fire a steam-engine and pumps used in the old wooden buildings, now abandoned, have been erected in the center of the court at the base of a tower of 100 feet in height, in which, at the height of 70 feet, is a watchman's room, from which every door in the warehouse is visible. Above the watchman's room is a tank containing a supply of water, with a head of 90 feet, to be used in case of need until steam is raised in the engine-boilers.

The building contains 150,000 square feet of warehouse floor, or very nearly $3\frac{1}{2}$ acres. Its storage capacity is about 2,700,000 cubic feet. It incloses $14\frac{1}{2}$ acres within its outer walls, and the court-yard contains $11\frac{1}{4}$ acres. It is plainly and substantially built, and being constructed, under contracts, now nearly completed, and for the amount of the original appropriation, which will not be exceeded, its cost will be \$150,000, which is at the rate of \$1 per square foot of warehouse floor, or $5\frac{1}{2}$ cents per cubic foot of storage room.

The result is creditable to Captain Hoyt, assistant quartermaster, under whose immediate supervision the work has been constructed; upon plans which I had the honor to submit to the Secretary, and which met his approval.

Its completion will place in safety a very large quantity and value of military material. The saving in expenses of watchmen and of provision of fire-engines and fire organization necessary in the old wooden buildings heretofore occupied, will be sufficient in a few years to pay for the whole cost of the warehouses.

Depot at San Antonio, Texas.

Difficulties and mistakes in the conveyance to the United States of a site for this depot, postponed the making of contracts for its erection until the act of 18th May, 1872, making appropriations for deficiencies, went into operation. As the buildings were to be of permanent construction, the money set aside for their erection has been returned to the Treasury.

The city of San Antonio has given to the United States a suitable site. Good store-houses for the depot at San Antonio are very desirable, and would, in a few years, save in rents, by dispensing with the use of hired buildings in that city, the \$100,000 which were devoted to their construction.

I trust that Congress will see fit to re-appropriate the money now returned to the Treasury, and to authorize the construction of a suitable depot at this central station.

It will be many years before the frontier line of posts in Texas, to which San Antonio is the natural central distributing depot, can be abandoned.

Plans of military posts and buildings.

The rude and temporary character of the buildings or huts erected hastily in the wilderness for the shelter of troops sent to occupy positions far from all markets and settlements, has led officers, in many cases, to neglect sending to the War Department full and intelligible plans of posts long occupied. I have constantly endeavored to remedy this defect in the records of this office, and have now, I believe, succeeded in completing a set of plans for every military post. Many of them are rude as the buildings they often represent, but they are intelligible, and, in all new constructions authorized, care is now taken to preserve true and accurate copies of all plans which the Secretary has approved. These plans are very necessary to enable the War Department to determine upon questions of additions, repairs, and estimates of cost constantly presented for its action.

Standard plans for temporary barracks and quarters at military posts in the West have been prepared and distributed. Copies thereof are submitted with this report.

EXPLORING EXPEDITIONS.

The expedition into Nevada and Arizona, under command of Lieutenant George M. Wheeler, of the Corps of Engineers, was supplied with transportation, animals, forage, and miscellaneous stores by this Department, and, under your instructions, sales of necessary small-stores to the civilian members of the expedition were authorized.

The geological survey of the fortieth parallel, under Clarence King, geologist, was, under like authority, provided with means of transportation and furnished with such other necessary articles of outfit as this Department ordinarily provides for the troops.

INDEBTED RAILROADS.

During the past fiscal year the balance due from railroads indebted to the United States for purchases of railroad material at the close of the war, has increased by accruing interest and expenses, exceeding the

payments made by the sum of \$10,091.90. The balance of this debt, on June 30, 1871, was \$4,734,442.43. The total collections during the year were \$138,132.75.

There are filed in this office claims for credits, on the part of certain indebted railroad companies, for services of military transportation which, when finally settled, will probably amount to about \$170,000, and some \$60,000 due for mail service are also applicable, though not yet applied to the reduction of this debt.

Two roads, the Memphis and Ohio and the Washington, Alexandria and Georgetown Railroad, extinguished their debt, during the year, by payment of \$12,415.57.

Eight roads, viz: the Alexandria, London and Hampshire, the East Tennessee and Virginia, the Knoxville and Kentucky, the Mississippi and Tennessee, the Nashville and Chattanooga, the New Orleans and Ohio, the Pacific Railroad of Missouri, and the Selma, Rome, and Dalton, have reduced their indebtedness, having paid during the year the sum of \$84,891.71.

There are ten companies whose indebtedness has, through accumulation of interest, increased during the year, notwithstanding the payment, by them, of the aggregate sum of \$84,294.91.

For details of these accounts I refer to the tabular statement which accompanies this report.

The act of 3d March, 1871, (16 Statutes, chapter 109, page 473,) empowered the Secretary of War to compromise suits brought against certain railroads on account of the bonds given by them under Executive orders to secure payment for railroad supplies sold to them at the close of the war.

The suits against the East Tennessee and Virginia, and the East Tennessee and Georgia Railroads, now consolidated and forming the East Tennessee, Virginia and Georgia Railroad, have been compromised for the sum of \$195,000, to be paid \$5,000 cash, \$95,000 in ten, and \$95,000 in fifteen years from January 1, 1872, with interest, payable annually, on the 1st day of January of each year, at the rate of four per cent. per annum, to be evidenced by two bonds of said companies to the United States for said sums, with interest coupons annexed, payment secured by a mortgage upon all the property, rights, and income, and by the lien of a decree to be entered in said cases, to be enforced by execution and sale in case of default.

The suit against the Nashville and Decatur Railroad Company is under consideration of the War Department, and in a fair way toward a satisfactory compromise.

In the suits against the Nashville and Northwestern, the McMinnville and Manchester, and the Knoxville and Kentucky Railroad Companies no progress is reported.

The Alabama and Chattanooga Company has been sold under proceedings in bankruptcy in the district court of the United States for the middle district of Alabama, the purchaser being the State of Alabama, at the price of \$312,000.

The claim of the United States has been filed with the register in bankruptcy, and its validity and justness recognized by the State. It is promised by the United States district attorney that the claim will be settled this fall.

In the suit against the New Orleans and Ohio Railroad Company, pending, as I reported, in the Supreme Court of the United States at the date of my last annual report, decision has been rendered in favor of the United States, and the sum of \$10,946.47, being the value of the

property upon which the United States retained a lien, has been paid and deposited in the Treasury of the United States. There remains a balance of \$25,529.17 unpaid, and the company being bankrupt, the road sold under the first and second mortgages, and all legal measures exhausted, there is no prospect of its recovery.

The Mobile and Ohio Railroad has filed accounts which, with its unpaid postage dues, are nearly, if not quite, sufficient to liquidate its debt to the Quartermaster's Department.

The claim against the Alabama and Florida Railroad Company, being for repairs to the road by the United States in 1865, being disputed by the company and appeal being taken by them to the accounting officers of the Treasury, these officers have differed with the Quartermaster General, and made an award in favor of the railroad company, which is now under consideration by the War Department.

The Mississippi, Gainesville and Tuscaloosa Railroad has been sold under its first mortgage to the Mobile and Ohio, and the Mobile and Ohio resists the payment of the debt of the former road. Prior to sale, such of the property purchased from the United States as had not been worn out and consumed was restored to possession of the United States, and realized, when sold, the sum of \$2,299, received and deposited to credit of Treasurer of the United States. About \$40,069.72 remain unpaid. Postal dues, properly applicable to reduction of this debt, are not applied to it, because the present owners of the road refuse to assent to such application.

During the fiscal year, the Quartermaster's Department collected in money and postal dues from the indebted railroads, the sum of \$118,294.47, all of which has been deposited to credit of the Treasurer of the United States on account of appropriations prior to July, 1870, and credited also upon the account of indebtedness of these railroads.

CLAIMS.

The act of 4th July, 1864, imposes upon the Quartermaster-General the duty of examining all claims for quartermaster's stores taken and used by the Army during the war and not paid for, in certain districts, and if convinced of their justice and of the loyalty of the claimant, and that they were used by the Army, then of referring them to the Third Auditor, with recommendation for settlement. The force at the disposal of this office has not enabled me to dispose of these claims as rapidly as is desirable.

During the fiscal year 665 such claims have been referred to the Third Auditor, with recommendation for the allowance of \$367,102.72. The claimants had stated their claims at \$777,337.67. They were reduced \$410,234.95, more than 50 per cent., by the examination of this office and its agents, who visit the locality of all important claims and there examine into the facts before reporting upon them. Two hundred and seventy-four such claims, stated at \$396,100.75, have, on examination, been rejected. At the close of the year there remained on file 10,351 claims under this law, stated at \$6,857,006.56.

Miscellaneous claims.

Two thousand three hundred and forty-six miscellaneous claims, stated at \$538,382.22, were examined in this office during the year and referred to the proper officers for settlement at \$506,350.71. Three hundred and twelve claims, stated at \$108,668.29, have been rejected.

There remained in the office at the close of the fiscal year 14,485 miscellaneous claims, stated at \$7,558,791.75. At the beginning of the fiscal year, the number in the office was 14,585, stated at \$7,457,183.82.

The number and amount of these miscellaneous claims settled during the year are but little greater than the amount of the new claims filed during the same period.

Since 1861, the commencement of the war, there have been filed in this office 66,096 miscellaneous claims, stated at \$34,919,569.08.

Accounts and claims for transportation.

During the year 325 accounts for transportation have been examined in this office and transmitted to disbursing officers or to the accounting officers of the Treasury for settlement, amounting to \$803,171.26; also 538 claims or accounts for transportation, amounting, as allowed here, to \$471,998.87, and 170 such claims, stated at \$1,911,722.36, have been rejected.

There remained in the office, not finally acted on, at end of the fiscal year, 22 transportation-accounts, \$2,587.43, and 134 claims on account of transportation, stated at \$275,057.02.

NATIONAL CEMETERIES.

There are 74 national military cemeteries, of which all but one, that at Antietam battle-field, are under the management of this Department. They contain the remains of 317,962 persons, of whom 170,162 are known and 147,800 are not identified.

During the year four bodies have been removed by friends, and one hundred and sixteen have been discovered, taken up, and interred in national cemeteries. These change the total reported last year.

The appropriation for the establishment and care of these cemeteries for the fiscal year was \$200,000, to which may be added \$50,000, appropriated in the deficiency bill in May, 1872, just before the close of the fiscal year.

Stone walls have been erected or begun during the year to inclose the following: Annapolis, Maryland; Nashville and Stone River, Tennessee; Marietta, Georgia; City Point, Virginia; Jefferson City and Springfield, Missouri; Salisbury, North Carolina, and Beverly, New Jersey. Brick walls have been erected at Corinth and Natchez, Mississippi, and at Camp Butler, Illinois.

Permanent lodges have been erected or are now erecting at Culpeper and Hampton, Virginia; Newberne and Wilmington, North Carolina; Nashville and Stone River, Tennessee; Corinth, Mississippi, and Jefferson City, Missouri.

Coping has been contracted for at certain cemeteries where walls had been originally erected without finished coping.

The expenses have been:

For inclosures and gates, and for walls, six and a quarter miles in all	\$106,994 01
Eight permanent lodges	35,410 70
Coping of stone, 7.92 miles	46,779 29
Labor	30,360 44
Repairs	23,361 25
Miscellaneous	7,094 31
Total	250,000 00

Permanent lodges are still needed at eleven national cemeteries, viz: Andersonville, Georgia; Brownsville, Texas; Camp Nelson, Kentucky;

Fayetteville, Arkansas; Beaufort, South Carolina; Fort Gibson, Indian Territory; Fort Leavenworth and Fort Scott, Kansas; Grafton, West Virginia; Knoxville and Pittsburgh Landing, Tennessee.

Permanent inclosures are needed at sixteen: They are Andersonville, Georgia; Culpeper, Fort Harrison, and Fredericksburgh, Virginia; Fayetteville and Fort Smith, Arkansas; Fort Gibson, Indian Territory; Fort Leavenworth and Fort Scott, Kansas; Lexington, Kentucky; Mound City, Illinois; Whitehall, (Bristol,) Pennsylvania; Grafton, West Virginia; Memphis, Tennessee; Chalmette, (New Orleans,) Louisiana, and Vicksburgh, Mississippi. The estimated cost of these works is \$247,000.

The Gettysburgh national cemetery, constructed with the aid of the War Department, by State action, has been transferred to the custody of the War Department, under the act of the legislature of Pennsylvania of 14th April, 1868, and the resolution of Congress of 14th July, 1870. The transfer was made on 18th April, 1872.

The Antietam Cemetery has not been transferred to the War Department.

The gateway to the Arlington Cemetery remains unfinished, though nearly complete. The contractor having failed, the work will be finished by the United States. A contract has been made for a similar gateway at the Nashville Cemetery, to be constructed of stone from that region of country.

Advertisements and notices have been published, inviting proposals for marking all the graves with head-stones, as required by the law of 8th June, 1872. The bids will be opened on the 12th October, in this city, and the award made by the Secretary of War, as required by the law.

The appropriation of \$200,000, made by Congress to carry this law into effect, cannot be sufficient to erect head-stones at 300,000 graves.

Twenty-six volumes of the Roll of Honor, lists of soldiers interred by the United States, have been published. Volumes 27 and 28, the latter a new and revised edition of the lists in volumes 1 and 4, and containing a record of 21,192 graves, are now in the hands of the printer, and volume 29 is in course of preparation.

The superintendents of national cemeteries have been classified as directed by the law of 18th May, 1872, with reference to the importance of their duties.

Superintendents are required at sixty-two cemeteries. Ten were appointed during the year, four resigned, two died, two were discharged, and fifty-nine were on duty at the close of the year.

The cemeteries have been kept in good order, and the work upon them during the year is believed to have been generally faithfully and economically done.

Some contractors have been careless in the quality of their masonry, and their work will need some repair and improvement. The system of competition and contract with the lowest bidder, required by law, is economical, and on the whole the best, but it is not always possible on work so widely scattered, and sometimes taken at insufficient prices, to secure as perfect workmanship as is desired.

FINANCE AND INSPECTION.

The labor of the branch of this office charged with the examination of estimates and requests for funds, and of remittances and of deposits, has been increased by late legislation, which requires, in all remittances, more strict attention to the several special appropriations than heretofore.

The weekly reports of officers, showing the balances in their hands and the places of their deposit, are examined in this branch and compared with the statements of the Treasurer of the United States of the balances appearing by reports of the depositaries.

All reports of inspection of property for condemnation and sale are examined in this branch of the office. The receipt and distribution of orders and general letters are in its charge.

During the year 62,500 copies of orders have been sent out, 4,900 circulars or general letters, 2,300 copies of the Roll of Honor, and 920 miscellaneous papers, besides the ordinary correspondence upon the financial business of the Department.

During the winter of 1871-'72, under your instructions, I passed over the Pacific Railroad and the routes of transportation into Arizona. From San Francisco I went by steamer to San Diego and thence rode across the Coast Range and the Colorado Desert to the Colorado River at Fort Yuma. I ascended the Gila Valley for a few miles, and, descending the Colorado to its mouth, returned to San Francisco by the steamer Newbern. This steamer was originally sent to the Pacific, by this Department, as a transport, to supply the troops in Alaska. On the withdrawal of the greater part of these troops and the establishment of private commercial lines of communication to Alaska, she was sold, and her purchasers have put her on the route between San Francisco and the head of the Gulf of California. She is met at the mouth of the Colorado by light-draught stern-wheel steamers belonging to the Colorado Steam Navigation Company, which transfer her freight and passengers to Yuma Depot at Arizona City, opposite Fort Yuma, and which, in the intervals of the monthly trips of the Newbern, carry freight and passengers as high up the Colorado as Fort Mohave. This line is a great advantage to the military service in Arizona. Troops arriving by the Newbern, after a sea-voyage of some ten days, are in better condition than those who have undergone the toilsome march of two hundred miles across the Colorado Desert, and those leaving Arizona, exhausted by its heat and aridity, find a grateful restorative in the sea-voyage along the coast of the Gulf of California and the Pacific.

The rates of freight are high—everything is costly in these desert regions—but the saving to the United States in the transportation of supplies for the 2,500 troops who, in Arizona, keep the Indians in check, and enable the citizens of the United States to pursue their avocations in comparative, though, I regret to say, by no means in entire safety, is very considerable.

It is impossible to convey to any one, who has not himself traveled in a sandy, stony, and rocky desert, any clear idea of the desolation of the regions through which the Lower Colorado and Gila flow. They are a true Sahara. The heat is intense; daily for some months it rises above 100° Fahrenheit in the shade. Rain is almost unknown. The common saying, when I visited the country in the spring of 1872, was that it had not rained for three years. This was not literally true, for the meteorological records at Fort Yuma show occasional showers, and sometimes they are severe; but they last but a short time. There is no rainy season, and the general character of the country and climate is that of extreme sterility, caused by the absence of moisture. In the valleys of the Gila and Colorado, a moderate breadth of bottom-land is capable of irrigation and cultivation, but the generally forbidding aspect of the country, the danger of robbery and murder from the roving bands of savages and of Mexicans, who cross the border from Sonora, have prevented any large settlements growing up on the lower

course of these rivers. Most of the people who live there depend upon the business of transportation of supplies to the Army and to the mines for their support, and were the Army withdrawn the settlers would quit that portion of the country. It is a most expensive country in which to conduct military operations and to maintain an army, but it is full of the precious metals. It is occupied by a small population, partly natives and partly emigrants from the East, all of whom the United States is bound, by its treaties with Mexico, from whom we acquired the country, and by our obligations to our own citizens, miners, and farmers, to protect. The country too embraces one of the routes for the trans-continental railroad below the line of deep snow, and the construction of that railroad will be the best and speediest and least costly mode of protecting the inhabitants from the Indians and Mexicans.

The officers who have been on duty in this office during the fiscal year are Colonel Robert Allen, assistant quartermaster-general, in charge of finance, of reports of inspection, of boards of survey, of estimates for funds, of general orders, and special orders.

Major J. D. Bingham, quartermaster, in charge of clothing, camp and garrison equipage, examination of accounts of officers making returns and reports of money and property, and of all the business connected with the national cemeteries.

Major M. I. Ludington, quartermaster, in charge of business relating to supplies of the Army, regular and miscellaneous, except clothing, camp and garrison equipage; of transportation of the Army and of its supplies, and of all claims growing out of such service and supplies; of the business relating to indebted railroads; to telegraphs; of barracks and quarters and hospitals and other military buildings; and of all claims for individual allowances, and of the records of this office.

I am indebted to these officers for assiduous attention to the duties with which they have been charged and for valuable assistance.

The most important other posts of the Quartermaster's Department have been filled by—

Colonel D. H. Rucker, who has been on duty as chief quartermaster Division of the Missouri, Chicago, Illinois.

Colonel Rufus Ingalls has been chief quartermaster, Department of the East, and in charge of general depot of the Quartermaster's Department at New York City.

Colonel L. C. Easton, assistant quartermaster-general, chief quartermaster Department of the Missouri to May 27, 1872, when he was transferred to Philadelphia to relieve Colonel Stewart Van Vliet.

Colonel Stewart Van Vliet, assistant quartermaster-general, chief quartermaster Military Division of the Atlantic, and in charge of the general depot at Philadelphia and of Schuykill arsenal until June 1, 1872, when relieved by Colonel L. C. Easton. Colonel Van Vliet is now on leave of absence and under orders for duty at Fort Leavenworth as chief quartermaster Department of the Missouri.

Lieutenant-Colonel J. C. McFerran, chief quartermaster Military Division and Department of the South, who died on the 25th April, 1872, to the great loss of this Department.

Lieutenant-Colonel S. B. Holabird, chief quartermaster Department of Dakota to April 30, 1872, and from June 6, 1872, chief quartermaster Department of Texas.

Lieutenant-Colonel R. O. Tyler, chief quartermaster Military Division of the Pacific.

Lieutenant-Colonel C. H. Tompkins, chief quartermaster Department of Arizona to December 29, 1871, when relieved by Major J. J. Dana,

and from May 1 chief quartermaster Department of Dakota, at Saint Paul, Minnesota.

Lieutenant-Colonel James A. Ekin, chief quartermaster Department of Texas, San Antonio, to April 26, 1872, and from May 8, 1872, chief quartermaster Department of the South, at Louisville, Kentucky.

Lieutenant-Colonel H. C. Ransom, chief quartermaster District of Montana, at Fort Shaw.

Lieutenant-Colonel A. R. Eddy, chief quartermaster Department of the South to January 31, 1872, when relieved by Lieutenant-Colonel J. C. McFerran; from February 3 to May 11, 1872, chief quartermaster Department of the Gulf; from June 1 on duty at the Philadelphia depot.

Lieutenant-Colonel Rufus Saxton, chief quartermaster Department of the Columbia, Portland, Oregon.

Major A. J. Perry, chief quartermaster Department of the Platte, Omaha, Nebraska.

Major H. C. Hodges, Schuylkill arsenal, and chief quartermaster third district, Department of the East, Philadelphia.

Major C. G. Sawtelle, chief quartermaster Department of California, San Francisco.

Major J. J. Dana, chief quartermaster Department of the Lakes, Detroit, Michigan, to October 31, 1871; from December 29, 1871, chief quartermaster Department of Arizona, at Prescott.

Major James M. Moore, in charge of division depot at Fort Leavenworth, Kansas.

Major William Myers, in charge of depot at Washington, District of Columbia.

Major B. C. Card, in charge of depot at San Antonio, Texas.

Captain C. H. Hoyt, in charge of general depot at Jeffersonville, Indiana.

Captain John F. Rodgers, military storekeeper at Jeffersonville, Indiana.

Captain V. P. Van Antwerp, military storekeeper at Schuylkill arsenal, Philadelphia, Pennsylvania.

I submit reports of the stations and duties of the officers of this Department.

I regret to report the death, on 25th April last, of Lieutenant-Colonel J. C. McFerran, while on duty as chief quartermaster of the Department of the South. During a long service in the Army he had well performed every duty committed to him and had secured the approbation and esteem of every commander. His death is a severe loss to the Quartermaster's Department. Captain David W. Porter, assistant quartermaster, died at Fort Quitman, Texas, on the 15th October, 1871.

Two assistant quartermasters, Captain Charles W. Thomas and George E. Alden, resigned during the year, and Military Storekeeper Captain W. G. Hodges was tried by court-martial at Galveston, and, on the 4th November, cashiered for misappropriating a sum of money, which he was compelled to replace before his dismissal.

REGULATIONS FOR MONEY AND PROPERTY ACCOUNTS.

The issue of General-Orders Nos. 64 and 68 has put into operation the system of property and money accounts, referred to, in my last annual report. The result of practical use has been favorable to the revised system, as simpler and involving less clerical labor than that which it has replaced.

SITES OF MILITARY POSTS IN TEXAS.

I again call your attention to the unfortunate condition of the tenure of the military posts on the frontier in Texas and renew the recommendation made last year on this subject.

Owing to the property in all public lands in Texas being in the State, and not in the United States, and to the restrictions imposed upon the War Department by the law of May 1, 1820, (Statutes at Large, volume 3, chapter 52, section 7, page 568,) which forbids the purchase of any lands for use of the United States without a special law authorizing it, most of the military posts in Texas have been established upon lands to which the United States has no title. These posts have generally been located far in advance of any settlement, and, when located, there has probably been generally no knowledge of the condition of the title, whether in the State, or taken up and entered under State laws by individuals. Such lands, until occupied and protected, have generally had very little value. Probably 25 cents per acre would be a large price for lands in the vicinity of most of the frontier posts in Texas, even after protection was assured by their occupation by troops of the United States; but the moment the United States begins to build shelter for the troops, the lands are, if the property of the State, entered by some citizen, or, if the property of an unlettered person, purchased by some man of business, who sees in them, occupied and improved by the United States, a prospect of great improvement in value and the foundation of a claim for rent or sale.

The War Department, in the present state of the law, is helpless in this matter. If the demands of those who hold title are extravagant, it has generally thus far declined to pay rent. It is prohibited by law from purchasing.

Some of the sites in Texas have a certain value as containing springs of water, which in some parts of that State are well-known stopping-places for traders and travelers and for warriors; and these springs are gradually being taken up and made private property at prices probably not exceeding 25 or 50 cents per acre for the land which must be entered in order to control them. Without the use of these springs, very large tracts in the neighborhood are valueless, indeed uninhabitable. I recommend that the attention of Congress be called to this subject and that the Secretary of War be clothed with authority to purchase the sites of such military posts as are already, or as may be within a few years, established in Texas, at prices which he may determine to be just and reasonable, considering the value of the land before its occupation by the United States. I see no other mode of settling a very disputed and important question. If this authority is granted, a moderate appropriation should be made to pay for the land. The sites, when occupied by the United States, had little intrinsic value. Their present value depends, in a great degree, upon the improvements made by the United States for the protection of the State and its inhabitants.

The reports of officers on duty in this office, which are herewith, and the accompanying tables, are referred to for information in detail upon the several subjects of this report.

Respectfully submitted.

M. C. MEIGS,

Quartermaster-General, Brevet Major-General, U. S. A.

HON. WILLIAM W. BELKNAP,
Secretary of War.

List of papers accompanying the annual report of the Quartermaster-General for the fiscal year ended June 30, 1872.

- 1.—Report of Colonel Robert Allen, assistant quartermaster-general U. S. A., of the inspection and finance branches of the Quartermaster-General's Office during the fiscal year ended June 30, 1872.
 Accompanying papers:
 A.—List of officers on duty in the Quartermaster's Department during the fiscal year.
 B.—List of line officers on duty as acting assistant quartermasters, and of the stations at which they have served during the fiscal year.
 C.—Report of the stations and duties of officers of the Quartermaster's Department on July 1, 1872.
- 2.—Report of Major J. D. Bingham, quartermaster U. S. A., of the operations of the accounting branch of the Quartermaster General's Office during the fiscal year ended June 30, 1872.
- 3.—Report of Major J. D. Bingham, quartermaster U. S. A., of the operations of the clothing branch of the Quartermaster General's Office during the fiscal year ended June 30, 1872.
 Accompanying papers:
 A.—Statement showing the quantity of clothing, camp and garrison equipage, and clothing materials in the hands of officers June 30, 1871, the quantity purchased, manufactured, sold, lost, and issued during the fiscal year, and quantity remaining on hand for the supply of the Army on June 30, 1872.
 B.—Statement showing expenditures on account of clothing, camp and garrison equipage, during the fiscal year.
 C.—Statement of amounts received from sales of clothing, camp and garrison equipage during the fiscal year.
 D.—Statement of the amounts received and expended on account of clothing and equipage during the fiscal year.
 E.—Statement of returns of clothing, camp and garrison equipage received, examined, and transmitted to the Treasury Department, and of letters received and written during the fiscal year.
- 4.—Report of Major J. D. Bingham, quartermaster U. S. A., of the operations of the cemeterial branch of the Quartermaster General's Office during the fiscal year ending June 30, 1872.
- 5.—Report of Major M. I. Ludington, quartermaster U. S. A., of the operations of the regular supplies, transportation, and barracks and quarters branch of the Quartermaster General's Office during the fiscal year ended June 30, 1872.
 Accompanying papers:
 A.—Statement of the indebtedness of southern railroad companies for railway material for the fiscal year.
 B.—Table of land-grant railroads.
 C.—Abstract of contracts for wagon transportation entered into by the Quartermaster's Department during the fiscal year.
 D.—Statement of vessels chartered, impressed, and employed during the fiscal year.
 E.—Statement of vessels owned or purchased by the Quartermaster's Department during the fiscal year.
 F.—Abstract of contracts for water-transportation during the fiscal year.
 G.—Statement of troops and stores transported during the fiscal year.
 H.—Statement of amounts paid on account of rail, river, stage, and wagon transportation during the fiscal year.
 I.—Statement of accounts and claims in transportation division for the fiscal year.
 K.—Statement of claims filed under act of July 4, 1864 during the fiscal year.
 L.—Statement of miscellaneous claims filed during the fiscal year.
- 6.—General Orders No. 64, War Department, Adjutant General's Office, October 25, 1871.
- 7.—General Orders No. 75, War Department, Adjutant General's Office, December 26, 1871.
- 8.—Pamphlet of drawings of military buildings recommended to the Secretary of War by the board on revision of the Army Regulations.
- 9.—List of number of interments of Union soldiers in national military cemeteries and information for bidders for furnishing headstones for the same.

1.—*Report of Colonel Robert Allen, assistant quartermaster-general, U. S. A.*

WAR DEPARTMENT, QUARTERMASTER-GENERAL'S OFFICE,
Washington, D. C., July 1, 1872.

GENERAL: I have the honor to submit herewith a report of the operations of the finance and inspection branches of this office during the fiscal year ended June 30, 1872.

FINANCE BRANCH.

The operations of this branch embrace action on estimates of funds; the preparation of requests for remittances to disbursing officers; the receipt, acknowledgment, and transmittal of all certificates of deposit made on account of sales of public property or as refundments, including the designation of appropriations to which the amounts should be credited upon being covered into the Treasury; the recording and reference to the Treasurer of the United States, for comparison with the records of his office, of the weekly statements of balances in hands of disbursing officers; the verification of the report of the Treasurer, with the statements of the officers, and the action thereon necessary to correct any discrepancies discovered.

Under recent laws and the new regulations in regard to rendition of accounts, the labor in this branch has been somewhat increased, and the number of its official communications written during the fiscal year exceeds 3,500, exclusive of correspondence had in connection with the weekly statement of funds.

INSPECTION BRANCH.

The duties of this branch continue as specified in previous annual reports, and are principally as follows:

Keeping narrative-reports of stations and duties of all officers performing duties in Quartermaster's Department.

Examining and preparing, for such action as may be requisite, proceedings of boards of survey, inventory and inspection reports, communications on assignments of officers and distribution of employes.

Filing and distribution of orders, circulars, and other printed documents.

Preparing monthly returns of officers of the departments for the Adjutant-General's Office.

Keeping books of "letters received" and "letters sent," relating individually to officers, agents, and employes of the Department.

During the fiscal year the corrected monthly returns of officers for 1863 and 1864 have been completed for the Adjutant-General's Office.

The following is an approximate statement of the number of orders, circulars and books received and distributed during the fiscal year:

	Received.	Distributed.
General orders, Quartermaster-General's Office		5,500
General orders, Adjutant-General's Office	41,300	39,000
General court-martial orders, Adjutant-General's Office	19,800	18,000
Circulars	6,600	4,900
Roll of honor	2,000	2,300
Hints on horseshoeing	1,000	780
Miscellaneous	1,530	920

During the same period about 1,086 inventory and inspection reports and 180 boards of survey have been examined, and, when necessary,

acted upon ; 4,028 entries have been made in the book of "letters received," above referred to, and 433 letters written and indorsements made, which are recorded in the corresponding book of "letters sent," besides a greater number recorded in other parts of the office. The current business of the branch is believed to have increased.

I respectfully inclose herewith lists of officers on duty in the Quartermaster's Department during the fiscal year; also, stations and duties of officers of the Department on July 1, 1872.

Very respectfully, your obedient servant,

ROBERT ALLEN,

Assistant Quartermaster-General.

Brigadier-General M. O. MEIGS,

Quartermaster-General U. S. A., Washington, D. C.

A.—Annual report of officers of the Quartermaster's Department for the fiscal year ending June 30, 1872.

No.	Name and grade.	Rank.	Duties, &c.
QUARTERMASTER-GENERAL.			
1	Montgomery C. Meigs	Brigadier-general and brevet major-general	In charge of the Quartermaster's Department at Washington, D. C.; from December 16, 1871, to March 23, 1872, absent in California and Arizona on an inspection tour.
ASSISTANT QUARTERMASTER-GENERALS.			
1	Robert Allen	Colonel and brevet major-general	On duty in the Quartermaster-General's Office at Washington, D. C.; from December 16, 1871, to March 23, 1872, on duty as acting Quartermaster-General.
2	Daniel H. Rucker	Colonel and brevet major-general	Chief quartermaster Military Division of the Missouri, and in charge of depot at Chicago, Ill.
3	Rufus Ingalls	Colonel and brevet major-general	Chief quartermaster Department of the East, and in charge of depot at New York City.
4	Langdon C. Easton	Colonel and brevet major-general	To May 27, 1872, chief quartermaster Department of the Missouri, at Fort Leavenworth, Kansas; thenceforward <i>en route</i> and chief quartermaster Military Division of the Atlantic, in charge of depot and Schuylkill arsenal at Philadelphia, Pa.
5	Stewart Van Vleet	Colonel and brevet major-general	To June 1, 1872, chief quartermaster Military Division of the Atlantic, in charge of depot and Schuylkill arsenal at Philadelphia, Pa.; thenceforward making transfers, and on leave of absence.
DEPUTY QUARTERMASTER-GENERALS.			
1	John C. McFerran	Lieutenant-colonel and brevet brigadier-general.	To January 15, 1872, chief quartermaster Military Division of the South, at Louisville, Ky.; thenceforward chief quartermaster Department of the South to April 25, 1872, on which date he died.
2	Samuel B. Holabird	Lieutenant-colonel and brevet brigadier-general.	To April 18, 1872, chief quartermaster Department of Dakota, at Saint Paul, Minn.; thenceforward chief quartermaster Department of Texas, at San Antonio, Texas.
3	Robert O. Tyler	Lieutenant-colonel and brevet major-general.	Chief quartermaster Military Division of the Pacific, at San Francisco, Cal.
4	Charles H. Tompkins	Lieutenant-colonel and brevet brigadier-general.	To December 29, 1871, chief quartermaster Department of Arizona, at Drum Barracks, Cal., and Prescott, A. T.; to April 15, 1872, <i>en route</i> , awaiting orders at San Francisco, Cal., and <i>en route</i> ; thenceforward chief quartermaster Department of Dakota, at Saint Paul, Minn.
5	James A. Ekin	Lieutenant-colonel and brevet brigadier-general.	To October 26, 1871, on sick leave; to April 26, 1872, chief quartermaster Department of Texas, at San Antonio, Texas; thenceforward <i>en route</i> and chief quartermaster Department of the South, at Louisville, Ky.
6	Frederick Myers	Lieutenant-colonel and brevet brigadier-general.	To November 20, 1871, on sick leave; thenceforward chief quartermaster District of New Mexico, at Santa Fe, N. M.
7	Hyatt C. Ransom	Lieutenant-colonel	Quartermaster District of New Mexico, and post quartermaster at Fort Shaw, M. T.
8	Asher R. Eddy	Lieutenant-colonel and brevet colonel	To January 30, 1872, chief quartermaster Department of the South, at Louisville, Ky.; from February 3 to May 19, 1872, chief quartermaster Department of the Gulf, and in charge of depot, at New Orleans, La.; thenceforward <i>en route</i> and chief quartermaster third quartermaster's district, Department of the East, at Philadelphia, Pa.

9	Rufa Saxton	Lieutenant-colonel and brevet brigadier-general.
QUARTERMASTERS.		
1	Alexander Montgomery	Major
2	Tredwell Moore	Major and brevet brigadier-general
3	Judson D. Brigham	Major and brevet brigadier-general
4	Alexander J. Perry	Major and brevet lieutenant-colonel
5	Henry C. Hodges	Major and brevet colonel
6	John G. Chandler	Major and brevet brigadier-general
7	Charles G. Sawtelle	Major and brevet brigadier-general
8	James J. Dana	Major and brevet brigadier-general
9	Joseph A. Potter	Major and brevet brigadier-general
10	Richard N. Batchelder	Major and brevet colonel
11	Marshall I. Ludington	Major and brevet lieutenant-colonel
12	James M. Moore	Major and brevet lieutenant-colonel
13	James Belger	Major
14	William Myers	Major and brevet brigadier-general
15	Herbert M. Enos	Major and brevet colonel
16	Benjamin C. Card	Major and brevet brigadier-general
ASSISTANT QUARTERMASTERS.		
1	Charles W. Thomas	Captain and brevet lieutenant-colonel
2	Charles A. Reynolds	Captain and brevet lieutenant-colonel
3	George B. Dandy	Captain and brevet brigadier-general
4	George H. Weeks	Captain and brevet lieutenant-colonel
5	Eliaz B. Carling	Captain and brevet lieutenant-colonel
6	William B. Hughes	Captain
Chief quartermaster Department of the Columbia, at Portland, Oregon: from August 25, 1871, to June 10, 1872, absent at Washington, D. C., engaged in the settlement of his accounts, and en route therefrom to Portland, Oregon.		
To June 1, 1872, quartermaster at Buffalo, N. Y., and in charge of the quartermaster's department at the various posts in Western New York; thenceforward transferring property, en route, and chief quartermaster second quartermaster's district, Department of the East, at Boston, Mass.		
Post quartermaster at Fort Adams, R. I.		
On duty in Quartermaster-General's Office at Washington, D. C.		
Chief quartermaster Department of the Platte, at Omaha, Neb.		
To May 24, 1872, chief quartermaster third quartermaster's district, Department of the East, at Philadelphia, Pa.; thenceforward engaged in the transfer of property, &c.		
To June 16, 1872, chief quartermaster second quartermaster's district, Department of the East, at Boston, Mass.; to June 28, transferring property and en route to Fort Leavenworth, Kansas, where, to June 30, receiving transfer of depot.		
Chief quartermaster Department of California, and in charge of depot at San Francisco, Cal.		
To October 31, 1871, chief quartermaster Department of the Lakes, at Detroit, Mich.; to January 11, 1872, transferring property, en route, and on special duty; thenceforward chief quartermaster Department of Arizona, at Prescott, A. T.		
To November 6, 1871, on sick leave, and awaiting orders, at Painesville, Ohio; thenceforward chief quartermaster Department of the Lakes, at Detroit, Mich.		
Chief quartermaster first quartermaster's district, Department of the East, at New York City.		
On duty in Quartermaster General's Office at Washington, D. C.		
In charge of depot at Fort Leavenworth, Kansas; from May 24 to June 30, 1872, acting chief quartermaster Department of the Missouri.		
To February 3, 1872, in charge of depot, and from November 28, 1871, also chief quartermaster Department of the Gulf, at New Orleans, La.; thenceforward transferring property and on duty as quartermaster at Galveston, Texas.		
In charge of depot at Washington, D. C.		
During the year sick at Waukesha, Wis.		
In charge of the depot at San Antonio, Texas.		
To May 31, 1872, settling accounts at Washington, D. C., when resignation accepted.		
In charge of depot at Cheyenne, W. T.		
In charge of depot and post quartermaster at Fort Abercrombie, D. T.		
To May 17, 1872, in charge of depot at Saint Louis, Mo.; thenceforward transferring property, en route, &c.		
Post quartermaster at Fort Monroe, Va.		
To April 30, 1872, on duty at Ogden, Utah Territory; thenceforward transferring property, chief quartermaster Department of the Gulf, and in charge of depot at New Orleans, La.		

A.—Annual report of officers of the Quartermaster's Department for the fiscal year ending June 30, 1872.—Continued.

No.	Name and grade.	Rank.	Duties, &c.
7	Augustus G. Robinson.....	Captain and brevet major.....	To May 20, 1872, post quartermaster at Fort Hays, Kansas; thenceforward transferring property, and <i>en route</i> to Fort Sill, Indian Territory.
8	Edward D. Baker.....	Captain.....	To December 31, 1871, post quartermaster at Camp Halleck, Nevada; to April 18, 1872, transferring property, awaiting orders, and <i>en route</i> ; to May 15, 1872, on duty at Ogden, U. T.; thenceforward on duty at Salt Lake City, Utah Territory.
9	Henry W. Jance.....	Captain and brevet lieutenant-colonel.....	In charge of depot at Fort Vancouver, W. T.; also, from August 23, 1871, to June 10, 1872, acting chief quartermaster Department of the Columbia, at Portland, Oregon.
10	Henry Inman.....	Captain and brevet lieutenant-colonel.....	To August 16, 1871, awaiting orders at Fort Abercrombie, D. T.; to October 31, 1871, on duty in the field in the Department of Dakota; thenceforward settling accounts, on leave of absence, on trial at Saint Paul, Minn., and awaiting orders at Fort Abercrombie, D. T.
11	James G. C. Lee.....	Captain and brevet lieutenant-colonel.....	In charge of depot at Yuma depot, A. T., from October 16, 1871, to January 29, 1872, on leave of absence and special duty.
12	James Gillies.....	Captain.....	Purchasing and disbursing quartermaster at Chicago, Ill.
13	Theodore J. Eckerson.....	Captain and brevet major.....	During year on sick leave and awaiting orders at Chester, Pa.
14	Andrew J. McGonnigle.....	Captain and brevet colonel.....	To September 10, 1871, in charge of depot at Fort Union, N. M.; from September 13 to November 21, 1871, chief quartermaster District of New Mexico, at Santa Fe, N. M.; thenceforward in charge of depot at Fort Union, N. M.
15	Edward B. Grimes.....	Captain and brevet major.....	To April 15, 1872, post quartermaster at Fort Wingate, N. M.; to May 18, 1872, transferring property and <i>en route</i> ; thenceforward in charge of depot at Saint Louis, Mo.
16	James W. Souly.....	Captain and brevet colonel.....	To August 6, 1871, post quartermaster at Ringgold Barracks, Texas; to December 23, 1871, <i>en route</i> , on leave of absence, and awaiting orders; to March 23, 1872, in charge of depot at Sioux City, Iowa; to April 26, 1872, transferring property, and <i>en route</i> ; thenceforward post quartermaster at Fort Rice, D. T.
17	William T. Howell.....	Captain and brevet major.....	To July 15, 1871, post quartermaster at Fort Griffin, Texas; to August 10, 1871, transferring property, &c., and <i>en route</i> ; to January 14, 1872, on duty in connection with the purchase of cavalry-horses at Fort Richardson, Texas; to March 8, 1872, <i>en route</i> and awaiting orders; thenceforward post quartermaster at Fort Griffin, Texas.
18	Charles W. Foster.....	Captain and brevet colonel.....	To October 4, 1871, in charge of depot and chief disbursing officer Northern District of Arizona, at Fort Whipple, A. T.; to November 3, 1871, transferring property, on committal duty, and <i>en route</i> ; to February 11, 1872, on duty at Ehrenburg, A. T.; to April 14, 1872, <i>en route</i> and awaiting orders; thenceforward in charge of depot at Saint Paul, Iowa.
19	George W. Bradley.....	Captain.....	In charge of depot at Charleston, S. C.
20	George E. Alden.....	Captain and brevet major.....	To December 11, 1871, when resignation accepted, on leave of absence, on court-martial duty, <i>en route</i> , and awaiting orders.
21	Simon F. Bartow.....	Captain and brevet lieutenant-colonel.....	A lieut-camp at headquarters Military Division of the Atlantic, at Philadelphia, Pa.
22	John H. Belcher.....	Captain and brevet major.....	In charge of depot at Omaha, Neb.
23	Ezra B. Kirk.....	Captain.....	Post quartermaster at Camp Supply Ind. Ter.
24	Amos S. Kimball.....	Captain.....	To August 22, 1871, on duty at Kit Carson, C.; T., to September 10, absent on

85	Almon F. Rockwell.....	Captain and brevet lieutenant-colonel.....	leave; to December 1, in charge of depot at Fort Union, N. M.; to December 8, transferring property and <i>en route</i> ; thenceforward post quartermaster at Fort Riley, Kans.
86	Gilbert C. Smith.....	Captain.....	Post quartermaster at Fort Sill, Ind. Ter.
87	Thomas B. Hunt.....	Captain and brevet lieutenant-colonel.....	Post quartermaster, and assistant to depot quartermaster at San Francisco, Cal. To August 8, 1871, post quartermaster at Fort Davis, Tex.; to August 31, transferring property, &c.; to October 23, in arrest, and awaiting result of a court of inquiry in his case; thenceforward <i>en route</i> on trial by general court-martial at Newport Barracks, Ky., and awaiting orders.
88	Edward J. Strang.....	Captain and brevet lieutenant-colonel.....	To July 31, 1872, transferring property at New Orleans, La., and <i>en route</i> ; thenceforward post quartermaster at Brownsville, Tex.
89	David W. Porter.....	Captain.....	Post quartermaster at Fort Quitman, Tex., to October 15, 1871, on which date he died.
90	Nathanial S. Constable.....	Captain.....	To July 13, 1871, transferring property at Fort Randall, D. T.; to August 12, <i>en route</i> , settling accounts, and on special duty at Saint Paul, Minn.; to August 21, <i>en route</i> , and awaiting orders at San Antonio, Tex., where, to March 12, 1872, engaged in the purchase of cavalry horses; thenceforward <i>en route</i> to and post quartermaster at Fort Concho, Tex.
91	John V. Furey.....	Captain.....	To December 1, 1871, in charge of depot at Sioux City, Iowa; to February 22, 1872, transferring property, and <i>en route</i> ; thenceforward on duty at Tucson, A. T.
92	Lewis C. Forsyth.....	Captain and brevet major.....	To July 31, 1871, <i>en route</i> and awaiting orders; thenceforward post quartermaster at Fort Ellis, M. T.
93	Charles H. Hoyt.....	Captain.....	In charge of depot at Jeffersonville, Ind.
94	Asa P. Blunt.....	Captain and brevet colonel.....	To May 17, 1872, post quartermaster at Fort Buford, D. T.; thenceforward <i>en route</i> and on leave of absence.
MILITARY STORE-KEEPERS.			
1	Reuben M. Potter.....	Captain.....	Acting assistant quartermaster at Pittsburgh, Pa.
2	Charles A. Allegood.....	Captain.....	Acting assistant quartermaster at Baltimore, Md.
3	John F. Rodgers.....	Captain.....	On duty at Jeffersonville, Ind.
4	Gustavus A. Hull.....	Captain.....	On duty as acting assistant quartermaster at Fort Sanders, W. T.
5	George H. A. Dimpfel.....	Captain.....	To April 10, 1872, settling accounts, awaiting orders, and <i>en route</i> in the Department of Arizona; thenceforward before retiring board, and awaiting orders at San Francisco, Cal.
6	William G. Hodges.....	Captain.....	Awaiting orders at Galveston, Tex., and New Orleans, La., to November 4, 1871, when cashiered.
7	Nathan D. A. Sawyer.....	Captain.....	To September 4, 1871, acting assistant quartermaster at Indianola, Tex.; thenceforward on same duty at Victoria, Tex.
8	John Livers.....	Captain.....	On duty at Fort Leavenworth, Kans.
9	Hamilton Lieber.....	Captain.....	On duty at Fort Snelling, Minn.
10	Verplanck Van Antwerp.....	Captain.....	On duty at Schuylkill arsenal, Philadelphia, Pa.
11	Addison Barrett.....	Captain.....	To September 1, 1871, on duty at San Francisco, Cal.; thenceforward on duty at Yerba Buena Island, California.
12	William P. Martin.....	Captain.....	To July 27, 1871, on duty at Charleston, S. C.; thenceforward acting assistant quartermaster at Columbia, S. C.

RECAPITULATION.

Grade.	In service at commence- ment of fis- cal year.	Resigned.	Died.	Cashiered.	Gained by promotion.	Lost by pro- motion.	In service at end of fiscal year.
Quartermaster-General, with rank of brigadier-general	1	.....	.....	.....	.....	.....	1
Assistant quartermaster-generals, with rank of colonel	3	.....	.....	.....	.....	.....	5
Deputy quartermaster-generals, with rank of lieutenant-colonel	8	.....	1	.....	.....	.....	8
Quartermasters, with rank of major	16	.....	.....	.....	3	3	16
Assistant quartermasters, with rank of captain	37	2	1	.....	.....	3	31
Military store-keepers, with rank of captain	12	.....	.....	1	.....	.....	11
Total	77	2	2	1	6	6	73

B.—List of officers on duty as acting assistant quartermasters, and of the stations at which they have served during the fiscal year ending June 30, 1872.

Name.	Lineal rank and regiment.	Brevet rank.	Station.	Time during year on duty as A. A. Q. M.
Abbott, L. A.	1st Lt. 6th Cav.		Fort Riley, Kans.	July 1 to Dec. 15, 1871.
Adams, H. H.	1st Lt. 18th Inf.		Chester, S. C.	May 1 to June 30, 1872.
Adams, John Q.	1st Lt. 1st Cav.		Camp Warner, Oreg.	Aug. 24, 1871, to June 30, 1872.
Aldrich, Bishop	1st Lt. & R. Q. M. 8th Inf.		David's Island, New York Harbor.	July 1, 1871, to June 30, 1872.
Allison, Jas. N.	2d Lt. 2d Cav.		North Platte, Nebr.	Jan. 31 to April 30, 1872.
Alleworth, Edward	2d Lt. 25th Inf.	1st Lt.	Fort Stockton, Texas.	April 1 to June 1, 1872.
Anderson, John	2d Lt. 18th Inf.		Columbia, S. C.	July 1 to 31, 1871.
Armstrong, R. G.	2d Lt. 1st Inf.		Newberry, S. C.	Oct. 23, 1871, to June 30, 1872.
Arnold, Isaac	Capt. Ord.		Fort Porter, N. Y.	July 1, 1871, to June 30, 1872.
Austin, Albert	2d Lt. 14th Inf.		Allegheny arsenal, Pa.	July 1, 1871, to May 30, 1872.
Bacon, George R.	2d Lt. 1st Cav.		Sidney Barracks, Nebr.	July 1, 1871, to May 5, 1872.
Badger, N. D.	1st Lt. 22d Inf.	Captain	Camp Halleck, Nev.	Jan. 1 to June 30, 1872.
			Whetstone Agency, Dak.	July 1, 1871, to April 30, 1872.
Bailey, E. L.	2d Lt. 4th Inf.	Lt.-Col.	Paducah, Ky.	July 1 to 10, 1871, and Jan. 3 to April 5, 1872.
Baldwin, F. D.	1st Lt. 5th Inf.		Fort Larned, Kans.	May 1 to June 30, 1872.
Baldwin, Jas. H.	1st Lt. & R. Q. M. 18th Inf.		Atlanta, Ga.	July 1 to Sept. 15, 1871.
Ball, Ed.	Capt. 2d Cav.		Fort Ellia, Mont.	July 1 to 31, 1871.
Bancroft, E. A.	1st Lt. & R. Q. M. 4th Art.		Fort McHenry, Md.	July 1, 1871, to June 30, 1872.
Bannister, John	2d Lt. 30th Inf.	1st Lt.	Fort Ransom, Dak.	Nov. 1, 1871, to Mar. 31, 1872.
Barnard, P. P.	2d Lt. 5th Cav.	Captain	Camp McDowell, Ariz.	Mar. 14 to June 30, 1872.
Barnhart, F. H.	2d Lt. 18th Inf.		Sumter, S. C.	July 1, 1871, to June 1, 1872.
Barrett, Gregory, jr.	1st Lt. & R. Q. M. 10th Inf.		Fort Brown, Texas.	July 1 to Aug. 31, 1871.
Bartlett, E. C.	1st Lt. 1st Cav.		Camp McDermit Nev.	Oct. 1 to 31, 1871.
Bascom, G. M.	1st Lt. & R. Q. M. 13th Inf.	Major	Camp Douglas, Utah.	Sept. 6 to Oct. 16, 1871.
			Fort Fred Steele, Wyo.	Nov. 1, 1871, to June 30, 1872.
Bateman, John C.	2d Lt. 2d Inf.		Huntsville, Ala.	Jan. 1 to 31, 1872.
Bates, R. F.	2d Lt. 18th Inf.	1st Lt.	Chester, S. C.	July 1, 1871, to April 30, 1872.
Beam, John W.	1st Lt. 15th Inf.	Captain	Expedition for removal of Apache Indians to Tularosa Reservation.	April 9 to June 30, 1872.
Beck, William H.	1st Lt. & R. Q. M. 10th Cav.		Fort Gibson, C. N.	June 14 to 30, 1872.
			Headquarters district Indian Territory.	June 3 to 30, 1872.
Beebe, William S.	1st Lt. Ord.	Major	Watervliet arsenal, N. Y.	Aug. 1, 1871, to June 30, 1872.
Bennett, C. E.	Capt. 17th Inf.		Grand River Agency, Dak.	July 1, 1871, to Feb. 29, 1872.
Benson, H. M.	1st Lt. 7th Inf.		Camp Baker, Mont.	July 1, 1871, to Oct. 21, 1871.
Bernard, R. F.	Capt. 1st Cav.	Colonel	Camp Bidwell, Cal.	July 1 to Aug. 30, 1871.
Bird, Charles	1st Lt. 23d Inf.	Lt.-Col.	Camp San Juan Island, Wash. Terr.	July 1 to Sept. 30, 1871.
Blair, Thomas	1st Lt. 15th Inf.		Fort Bayard, New Mex.	Jan. 31 to June 30, 1872.
Bogle, A.	1st Lt. 25th Inf.	Captain	Fort Duncan, Texas.	July 1 to Aug. 31, 1871.
Bonsall, S. W.	1st Lt. 3d Inf.		Fort Lyon, Colo.	July 1 to Oct. 31, 1871.
Booth, Charles A.	2d Lt. 1st Inf.		Fort Reynolds, Colo.	Nov. 14, 1871, to May 31, 1872.
Boswell, B. D.	2d Lt. 11th Inf.	Captain	Fort Brady, Mich.	Oct. 17, 1871, to June 30, 1872.
Boutelle, F. A.	2d Lt. 1st Cav.		Jefferson, Texas.	July 1 to Nov. 1, 1871.
Boyd, O. B.	1st Lt. 8th Cav.		Fort Klamath, Oreg.	July 1 to Oct. 31, 1871.
			Fort Stanton, New Mex.	July 1 to Oct. 1, 1871.
			Camp near Fort Bascom, New Mex.	June 19 to 30, 1872.
Braden, Charles	2d Lt. 7th Cav.		Winnabourgh, S. C.	July 1 to Oct. 31, 1871.
Bradford, R. E.	1st Lt. 15th Inf.		Fort McRae, New Mex.	July 1 to Dec. 13, 1871.
Bradley, James H.	1st Lt. 7th Inf.		Fort Benton, Mont.	April 30 to June 30, 1872.
Brinckle, J. R.	1st Lt. 5th Art.	Major	Fort Warren, Mass.	July 1, 1871, to June 30, 1872.
Brinkerhoff, H. R.	1st Lt. 15th Inf.		Fort Wingate, N. Mex.	April 15 to June 30, 1872.
Brodie, A. O.	2d Lt. 1st Cav.		Camp Apache, Ariz.	July 1 to 31, 1871.
Bronson, Nelson	2d Lt. 6th Inf.		Fort Larned, Kans.	April 1 to May 1, 1872.
Brown, R. P.	2d Lt. 4th Inf.		Lexington, Ky.	July 1 to Dec. 12, 1871, and Dec. 24, 1871, to June 30, 1872.
Brown, W. H.	Capt. 5th Cav.	Major	North Platte, Neb.	Oct. 31 to Nov. 23, 1871.
Brush, D. H.	2d Lt. 17th Inf.		Grand River Agency, Dak.	May 1 to June 30, 1872.
Bubb, John W.	1st Lt. & R. Q. M. 14th Inf.		Frankfort, Ky.	May 1 to June 30, 1872.
Buffum, M. P.	1st Lt. 15th Inf.	Major	Fort Craig, N. Mex.	July 1 to Oct. 26, 1871.
			Fort Tularosa, N. M.	May 6 to June 30, 1872.
Burnett, L. F.	2d Lt. 7th inf.	Captain	Fort Benton, Mont.	July 1, 1871, to April 30, 1872.
Butler, William P.	2d Lt. Ord.		Rock Isl'd arsenal, Ill.	Aug. 5, 1871, to June 30, 1872.
Calhoun, James	1st Lt. 7th Cav.		Elizabethtown, Ky.	Jan. 8 to June 30, 1872.

B.—List of officers on duty as acting assistant quartermasters, &c.—Continued.

Name.	Lineal rank and regiment.	Brevet rank.	Station.	Time during year on duty as A. A. Q. M.
Callahan, C. M.	1st Lt. 3d Art.	Captain.	Summerville, S. C.	Oct. 25 to Nov. 23, 1871.
Callinan, D. F.	1st Lt. 1st Inf.		Fort Brady, Mich.	July 1 to Oct. 19, 1871.
Camp, E. M.	1st Lt. 12th Inf.	Captain.	Angel Island, Cal.; Camp McDermitt, Nev.	July 1 to Aug. 16, 1871. May 31 to June 30, 1872.
Campbell, Charles E.	2d Lt. 3d Inf.		Fort Larned, Kans.	July 1, 1871, to April 1, 1872.
Campbell, L. E.	1st Lt. 22d Inf.		Sioux City, Iowa.	Dec. 25 to 31, 1871.
Campbell, W. J.	2d Lt. 23d Inf.		Fort Randall, Dak.	Aug. 1, 1871, to June 30, 1872.
Campion, William H.	1st Lt. 4th Inf.		Paducah, Ky.	July 10, 1871, to Jan. 3, 1872.
Capron, T. H.	1st Lt. 9th Inf.		Camp Vincent, Neb.	May 1 to June 30, 1872.
Carey, A. B.	Major & P. M.	Lt.-Col.	Santa Fé, N. M., (acting C. Q. M. of dist.)	July 15 to Aug. 31, 1871.
Carland, John	1st Lt. & R. Q. M. 6th Inf.		Fort Gibson, I. T.	July 1, 1871, to May 4, 1872.
Catley, Henry	1st Lt. 2d Inf.		Montgomery, Ala.	July 1 to 31, 1871.
Cavensough, H. G.	1st Lt. 13th Inf.		Camp Douglas, Utah.	Oct. 16, 1871, to June 30, 1872.
Chamberlain, H. B.	2d Lt. 10th Inf.		Fort McIntosh, Texas.	July 1, 1871, to May 8, 1872.
Chamberlin, L. A.	1st Lt. 1st Art.		Fort Wadsworth, N. Y. Harbor.	July 1, 1871, to June 30, 1872.
Chance, J. C.	2d Lt. 13th Inf.		Fort Fred Steele, Wyo.	July 1 to Nov. 1, 1871.
Chase, Constantine	1st Lt. 3d Art.		Key West, Fla.	July 1 to Sept. 30, 1871.
Clague, John J.	2d Lt. 12th Inf.		Fort Yuma, Cal.	July 1, 1871, to April 29, 1872.
Clark, E. R.	2d Lt. 10th Inf.		Austin, Texas.	July 1, 1871, to June 30, 1872.
Clark, S. E.	2d Lt. 3d Inf.	Captain.	Mobile, Ala.	July 1, 1871, to Jan. 13, 1872.
Clifford, J. C.	2d Lt. Ord.		Benicia arsenal, Cal.	July 1, 1871, to June 30, 1872.
Coe, John N.	Capt. 20th Inf.		Fort Totten, Dak.	July 31, 1871, to June 30, 1872.
Conrad, C. H.	1st Lt. 15th Inf.		Newport Barracks, Ky.	April 8 to June 30, 1872.
Cotton, G. P.	2d Lt. 1st Art.		Fort Niagara, N. Y.	July 1, 1871, to Jan. 9, 1872.
Courtney, M. L.	1st Lt. 25th Inf.	Major.	Fort Duncan, Texas.	Nov. —, 1871, to April 1, 1872.
Coxe, R. E.	2d Lt. 8th Cav.		Fort Selden, N. Mex.	July 31 to Dec. 15, 1871.
Craft, D. L.	2d Lt. 6th Inf.	Captain.	Fort Smith, Ark.	Sept. 30 to Nov. 15, 1871.
Craig, Samuel.	1st Lt. 8th Inf.		Chicago, Ill.	Nov. 3 1871, to May 3, 1872.
Craigie, D. J.	1st Lt. 12th Inf.	Captain.	Beaver City, Utah. Yuma Depot, Ariz.	May 25 to June 30, 1872. July 1 to 29, 1871.
Cranston, J. R.	2d Lt. 10th Inf.		Angel Island, Cal.	Aug. 16, 1871, to June 30, 1872.
Crawford, E.	1st Lt. 3d Cav.		Brazos Santiago, Tex. Camp on Laramie River, Wyo.	July 1, 1871, to June 30, 1872. May 10 to June 30, 1872.
Craycroft, W. T.	2d Lt. 7th Cav.		Bagdad, Ky.	July 1 to Sept. 1, 1871.
Crosby, Eben	2d Lt. 17th Inf.		Shelbyville, Ky. Grand River Agency, Dak.	Oct. —, 1871, to Oct. 10, 1871. Feb. 29 to April 30, 1872.
Cushing, H. C.	1st Lt. 4th Art.	Major.	Raleigh, N. C.	July 1 to Sept. 21, 1871.
Cushing, S. T.	Capt. and C. S.	Major.	San Antonio, Texas; (acting C. Q. M. and Depot Q. M.)	Sept. 15 to Oct. 21, 1871.
Cusick, C. C.	2d Lt. 22d Inf.		Lower Brulé Agency, Dak.	July 1 to Aug. 13, 1871.
Custer, B. M.	1st Lt. 24th Inf.		Fort Davis, Texas.	Aug. 8, 1871, to May 31, 1872.
Custer, Thomas W.	1st Lt. 7th Cav.	Lt.-Col.	Darlington, S. C. Unionville, S. C.	July 1 to Oct. 31, 1871. Nov. 7, 1871, to Jan. 31, 1872, and May 15 to June 30, 1872.
Davis, C. E. L. B.	1st Lt. Eng.		Willett's Point, N. Y. Harbor.	July 1, 1871, to June 30, 1872.
Davis, Charles L.	1st Lt. 10th Inf.	Major.	Ringgold Bar'sks, Tex.	Jan. 1 to June 30, 1872.
Davis, George B.	2d Lt. 5th Cav.		Camp Bowie, Ariz.	Feb. 16 to June 30, 1872.
De Lany, C. M.	2d Lt. 15th Inf.		Fort Bascom, N. Mex.	July 21, 1871, to June 30, 1872.
De Lany, H.	2d Lt. 9th Inf.	1st Lt.	Camp Ruggles, Neb.	July 1 to Nov. 30, 1871.
Dempsey, C. A.	1st Lt. 2d Art.		Chattanooga, Tenn.	July 1 to Dec. 31, 1871.
De Russy, R. E.	1st Lt. 2d Art.		Camp Tulare, Cal.	July 1 to 10, 1871.
Doshier, George W.	2d Lt. 1st Art.		Fort Ontario, N. Y.	July 1, 1871, to June 30, 1872.
Dodge, F. L.	2d Lt. 23d Inf.		Camp Harney, Oreg.	Oct. 21 to Nov. 30, 1871.
Dodge, H. C.	1st Lt. 2d Art.	Captain.	Sitka, Alaska.	May 31 to June 30, 1872.
Dove, William E.	1st Lt. 12th Inf.		Camp Independence, Cal.	July 1, 1871, to June 30, 1872.
Drow, George A.	1st Lt. 3d Cav.	Captain.	Camp Bowie, Ariz.	July 1 to Dec. 31, 1871.
Dudley, E. S.	2d Lt. 2d Art.		Fort Cape Diappointment, Wash. Terr.	July 1, 1871, to June 30, 1872.
Duff, George	2d Lt. 1st Inf.		Fort Gratiot, Mich.	July 1, 1871, to June 30, 1872.
Dutton, C. E.	1st Lt. Ord.		Washington arsenal, D. C.	Nov. 6, 1871, to June 30, 1872.
Eagan, Charles P.	1st Lt. 12th Inf.		Camp Mojave, Ariz.	July 1 to Dec. 31, 1871.
Eakin, C. P.	1st Lt. 1st Art.	Major.	Fort Wood, N. Y. Harbor.	July 1 to Aug. 1, 1871.
Eastman, James E.	1st Lt. 2d Art.		Alcatraz Island, Cal.	July 1, 1871, to June 30, 1872.
Eaton, John B.	1st Lt. 3d Art.	Captain.	Summerville, S. C.	Aug. 30 to Oct. 25, 1871.
Elstein, F. H. E.	2d Lt. 21st Inf.		Camp Date Creek, Ariz.	July 1, 1871, to June 30, 1872.
Edgerly, W. S.	2d Lt. 7th Cav.		Meridian, Miss.	Sept. 5 to Nov. 6, 1871.
Edie, John R., jr.	Captain Ord.	Major.	Opelika, Ala. Washington arsenal, D. C.	March 19 to June 30, 1872. July 1 to 15, 1871.
Egbert, A. R.	2d Lt. 2d Inf.		Tallahassee, Fla.	July 1 to 4, 1871.

B.—List of officers on duty as acting assistant quartermasters, &c.—Continued.

Name.	Lineal rank and regiment.	Brevet rank.	Station.	Time during year on duty as A. A. Q. M.
Elderkin, W. A	Capt. and C. S.	Major	Denver, Colo	July 1, 1871, to May 13, 1872.
Engle, John B.	1st Lt. 15th Inf.	.....	Pueblo, Colo	May 13 to June 30, 1872.
English, William L.	2d Lt. 7th Inf.	.....	Fort Craig, N. M.	Oct. 26, 1871, to June 30, 1872.
Eskridge, R. I.	1st Lt. 23d Inf.	Captain.	Fort Buford, Dak.	May 17 to June —, 1872.
Evans, George W.	1st Lt. 21st Inf.	do	Fort Vancouver, Wash.	July 1, 1871, to Jan. 31, 1872.
Everett, William	2d Lt. 4th Art.	.....	Drum Barracks, Cal.	July 1 to Aug. 31, 1871.
Ewing, E. S.	1st Lt. 16th Inf.	Major	Fort Washington, Md.	July 1, 1871, to Mar. 31, 1872.
Feehet, E. O.	2d Lt. 2d Art.	.....	Humboldt, Tenn.	July 1 to Aug. 11, 1871.
Ferris, S. P.	Capt. 4th Inf.	Major	Fort Stevens, Oreg.	Sept. 1, 1871, to June 30, 1872.
Fitch, J. R.	1st Lt. 15th Inf.	.....	Lebanon, Ky.	May 6 to June 30, 1872.
Fleming, W. W.	1st Lt. 12th Inf.	.....	Fort Cummings, N. M.	Jan. 3 to Feb. 14, 1872.
Footo, George F.	1st Lt. & R. Q. M. 8th Cav.	Captain.	Beales' Springs, Ariz.	July 1, 1871, to May 10, 1872.
Forse, A. G.	1st Lt. 1st Cav.	.....	Fort Union, N. M.	July 1 to Sept. 30, 1871, and May 1 to June 30, 1872.
Fowler, J. L.	1st Lt. 2d Cav.	.....	Cavalry Depot, Saint Louis, Mo.	Aug. 10 to Aug. 30, 1871.
Fuger, Frederick	1st Lt. 4th Art.	Captain.	North Platte, Nebr.	Nov. 25, 1871, to Jan. 31, 1872.
Gallagher, M. F.	2d Lt. 2d Inf.	Captain.	Fort Foote, Md.	July 1, 1871, to June 30, 1872.
Garvey, Thomas	2d Lt. 1st Cav.	.....	Fort Washington, Md.	June 20 to June 30, 1872.
Gibbs, E. B.	1st Lt. 6th Inf.	.....	Spartanburgh, S. C.	Feb. 1 to May 15, 1872.
Gibson, F. M.	2d Lt. 7th Cav.	.....	In field near Camp McDowell, Ariz.	Sept. 10 to Nov. 11, 1871.
Gilbreth, B. H.	Capt. & O. S. K.	.....	Camp McDowell, Ariz.	Nov. 30, 1871, to Mar. 31, 1872.
Gilbreath, E. C.	1st Lt. 11th Inf.	.....	Louisville, Ky., office of C. Q. M.	July 1, 1871, to June 30, 1872.
Godwin, E. A.	2d Lt. 8th Cav.	.....	Bagdad, Ky.	Sept. 1 to 28, 1871.
Goodloe, A. H.	1st Lt. & R. Q. M. 22d Inf.	.....	Shelbyville, Ky.	Sept. 28 to Oct. —, 1871.
Gordon, Charles G.	1st Lt. 6th Cav.	.....	Champlain arsenal, Vt.	July 17, 1871, to June 30, 1872.
Gottshall, John	2d Lt. 10th Inf.	.....	Fort Griffin, Tex.	July 15 to Aug. 3, 1871.
Grant, Alexander	1st Lt. 1st Cav.	.....	Fort Selden, N. M.	Dec. 15, 1871, to June 30, 1872.
Grealish, M. J.	Capt. & O. S. K.	.....	Fort Sully, Dak.	July 1 to Sept. 22, 1871, and May 1 to June 30, 1872.
Greene, A. P.	1st Lt. 4th Art.	.....	Camp near Fort Hays, Kans.	July 1 to Oct. 23, 1871.
Grier, M. C.	1st Lt. 4th Art.	.....	Ringgold Barracks, Tex.	Aug. 15 to Dec. 31, 1871.
Grimes, George S.	1st Lt. 2d Art.	.....	Camp Verde, Ariz.	Dec. 4, 1871, to Mar. 21, 1872.
Groesbeck, S. W.	2d Lt. 6th Inf.	.....	Pikeville Arsenal, Md.	July 1, 1871, to June 30, 1872.
Guthrie, J. B.	1st Lt. 13th Inf.	.....	Fort Macon, N. C.	Oct. 1, 1871, to June 30, 1872.
Haines, Abner, Jr.	1st Lt. 2d Inf.	.....	Fort Washington, Md.	Mar. 31 to June 30, 1872.
Hall, R. M.	1st Lt. & R. Q. M. 1st Art.	Colonel.	Fort Foote, Md.	June 20 to 30, 1872.
Hall, William P.	2d Lt. 5th Cav.	.....	Fort Whipple, Va.	July 1, 1871, to June 30, 1872.
Halloran, James	1st Lt. 12th Inf.	.....	Little Rock, Ark.	July 1 to Oct. 15, 1871.
Hamner, William H.	2d Lt. 20th Inf.	.....	Camp Stambaugh, Wyo.	July 1 to Oct. 8, 1871.
Hannay, John W.	2d Lt. 3d Inf.	.....	Camp Brown, Wyo.	Oct. 20, 1871, to June 30, 1872.
Harrold, C. W.	1st Lt. 3d Art.	.....	Spartanburgh, S. C.	Aug. 1, 1871, to Jan. 31, 1872.
Hart, Daniel	1st Lt. 25th Inf.	Major	Fort Hamilton, N. Y. Harbor.	July 1, 1871, to June 30, 1872.
Harwood, Paul	1st Lt. 20th Inf.	.....	North Platte, Nebr.	Jan. 1 to Oct. 31, 1871.
Hartz, W. T.	1st Lt. 15th Inf.	Major	Camp Wright, Cal.	Jan. 1 to June 30, 1872.
Hathaway, F. H.	2d Lt. & R. Q. M. 5th Inf.	Captain.	Fort Ripley, Minn.	July 1, 1871, to Mar. 31, 1872.
Haughhey, James A.	1st Lt. 21st Inf.	.....	Fort Reynolds, Colo.	May 31 to June 30, 1872.
Hawley, William	1st Lt. 20th Inf.	.....	Fort Pulaski, Ga.	July 1, 1871, to May 31, 1872.
Hayes, E. M.	1st Lt. & R. Q. M. 5th Cav.	.....	Fort Bliss, Tex.	July 1, 1871, to June 30, 1872.
Hein, O. L.	2d Lt. 1st Cav.	.....	Fort Pembina, Dak.	July 1, 1871, to June 30, 1872.
Hill, R. M.	Captain Ord.	Major	Fort Bascom, N. M.	July 1 to 21, 1871.
Hobbs, C. W.	2d Lt. 3d Art.	Captain.	Fort Garland, Colo.	May 17 to June 30, 1872.
Hodgson, B. H.	2d Lt. 7th Cav.	.....	Fort Leavenworth, Kans.	July 1, 1871, to June 30, 1872.
Hofman, William E.	1st Lt. 9th Inf.	.....	Ehrenberg, Ariz.	Feb. 11 to June 30, 1872.
Holden, E. S.	2d Lt. 4th Art.	.....	Fort Wadsworth, Dak.	July 1, 1871, to Jan. 31, 1872.
Howard, C. O.	2d Lt. 2d Art.	.....	Fort McPherson, Nebr.	July 1, 1871, to Mar. 31, 1872.
Howard, O. H.	2d Lt. 5th Art.	Major	Camp Verde, Ariz.	Mar. 21 to June 30, 1872.
Howe, Albion	1st Lt. 4th Art.	Captain.	Indianapolis arsenal, Ind.	July 1, 1871, to June 30, 1872.
Howe, Walter	2d Lt. 4th Art.	.....	Key West, Fla.	Oct. 1, 1871, to June 30, 1872.
Hoyt, George S.	2d Lt. 16th Inf.	.....	Unionville, S. C.	July 1 to 25, 1871.
Hubbard, E. B.	1st Lt. 2d Art.	.....	Fort Sanders, Wyo.	Oct. 9 to 24, 1871.
Hudson, C. L.	1st Lt. 4th Cav.	Captain.	Fort Johnston, N. C.	July 1 to 31, 1871.
Humphrey, C. F.	1st Lt. 4th Art.	.....	Point San José, Cal.	July 1, 1871, to Jan. 17, 1872.
			Fort Trumbull, Conn.	July 1, 1871, to June 30, 1872.
			Rutherfordton, N. C.	July 1 to Sept. 4, 1871.
			Charlote, N. C.	Mar. 16 to June 30, 1872.
			Fort Macon, N. C.	July 1 to Oct. 1, 1871.
			Atlanta, Ga.	Sept. 15, 1871, to June 30, 1872.
			Camp San Juan Island, Wash. Ter.	Jan. 4 to June 30, 1872.
			Fort Concho, Texas	July 1 to 9, 1871.
			Fort Johnston, N. C.	Aug. 1 to 24, 1871, and Oct. 1, 1871, to June 30, 1872.

B.—List of officers on duty as acting assistant quartermasters, &c.—Continued.

Name.	Lineal rank and regiment.	Brevet rank.	Station.	Time during year on duty as A. A. Q. M.
Tumpley, C. F.	1st Lt. 4th Art.	.....	Camp Seymour, N. C.	Aug. 24 to Oct. 1, 1871.
Hunter, Ed.	1st Lt. & R. Q. M. 1st Cav.	.....	Benicia Barracks, Cal.	July 1, 1871, to June 30, 1872.
Hurst, J. H.	2d Lt. 12th Inf.	Captain.	Camp Wright, Cal.	July 1 to Dec. 31, 1871.
Ingersoll, Edward	Capt. & O. S. K.	Major.	Beales' Springs, Ariz.	May 10 to June 30, 1872.
Ives, R. A.	2d Lt. 5th Art.	.....	Springfield Armory, Mass.	July 1, 1871, to June 30, 1872.
Jacob, R. T. Jr.	2d Lt. 6th Inf.	.....	Fort Preble, Me.	July 1, 1871, to June 30, 1872.
Jocelyn, S. F.	1st Lt. 21st Inf.	.....	Fort Dodge, Kans.	Nov. 15, 1871, to Apr. 30, 1872.
Johnson, H. C.	2d Lt. 23d Inf.	.....	Camp McDowell, Ariz.	Aug. 15 to Oct. 21, 1871.
Johnston, John L.	1st Lt. & R. Q. M. 21st Inf.	.....	Camp San Juan Island, Wash. Ter.	Sept. 30, 1871, to Jan. 4, 1872.
Jones, E. P.	Capt. & O. S. K.	.....	Tucson, Ariz.	July 1, 1871, to Feb. 23, 1872.
Jones, F. B.	1st Lt. & R. Q. M. 3d Inf.	.....	Columbus arsenal, O.	Sept. 1 to Dec. 3, 1871.
Jones, S. R.	1st Lt. 4th Art.	.....	Fort Dodge, Kans.	July 1 to Nov. 15, 1871.
Jordan, Charles.	2d Lt. 6th Inf.	.....	Fort Wallace, Kans.	Dec. 1, 1871, to April 30, 1872.
Keeffe, Joseph	1st Lt. 5th Art.	Captain.	Fort Hays, Kans.	May 20 to June 30, 1872.
Kelton, D. H.	1st Lt. 10th Inf.	.....	Raleigh, N. C.	April 30 to June 30, 1872.
Kendall, F. A.	1st Lt. 25th Inf.	Captain.	Jackson, Miss.	July 1, 1871, to June 30, 1872.
Kendall, H. M.	1st Lt. 6th Cav.	.....	Plattsburgh Barracks, N. Y.	July 1, 1871, to June 30, 1872.
Kilbourne, C. E.	1st Lt. 2d Art.	.....	San Antonio, Texas.	May 8 to June 30, 1872.
King, A. D.	1st Lt. 3d Cav.	.....	Fort Duncan, Texas.	Aug. 31 to Nov. —, 1871.
King, James S.	1st Lt. 12th Inf.	.....	Oxford, Miss.	Jan. 28 to June 30, 1872.
Kingsbury, George W.	2d Lt. 12th Inf.	1st Lt.	Fort Stevens, Oreg.	July 1 to Sept. 1, 1871.
Kingsbury, H. P.	2d Lt. 6th Cav.	.....	Camp McDowell, Ariz.	Oct. 21 to Nov. 30, 1871.
Knox, Thomas T.	2d Lt. 1st Cav.	.....	Fort Hall, Idaho	Mar. 31 to June 30, 1872.
Krazynski, M.	2d Lt. 12th Inf.	.....	Camp Gaston, Cal.	July 1, 1871, to June 30, 1872.
Krause, William	1st Lt. 3d Inf.	.....	Saltillo, Miss.	Feb. 1 to Mar. 6, 1872.
Kress, John A.	1st Lt. Ord.	.....	Meridian, Miss.	Mar. 6 to June 30, 1872.
Kyle, William J.	1st Lt. 11th Inf.	.....	Camp McDermitt, Nev.	Nov. 1 to 30, 1871, and Mar. 10 to May 31, 1872.
Lafferty, John	1st Lt. 8th Cav.	.....	Camp Mojave, Ariz.	Jan. 1 to June 30, 1872.
Lambert, John J.	2d Lt. 5th Inf.	.....	Fort Dodge, Kans.	April 30 to June 30, 1872.
Larned, C. W.	2d Lt. 7th Cav.	.....	Vancouver arsenal, Wash.	July 1, 1871, to June 30, 1872.
Lawton, H. W.	1st Lt. 4th Cav.	.....	Fort Richardson, Tex.	June 1 to 30, 1872.
Lee, J. M.	1st Lt. 9th Inf.	.....	Fort Union, N. Mex.	Dec. 1, 1871, to April 30, 1872.
Leefe, John G.	1st Lt. & R. Q. M. 19th Inf.	Captain.	Fort Reynolds, Colo.	July 1 to Nov. 14, 1871.
Lewis, Granville	1st Lt. 5th Inf.	.....	Louisville, Ky.	Feb. 29 to April 1, 1872.
Lord, J. H.	1st Lt. & R. Q. M. 2d Art.	Major.	Fort Richardson, Tex.	Feb. 4 to June 1, 1872.
Lord, Thomas W.	2d Lt. 20th Inf.	.....	Fort D. A. Russell, Wyo.	Jan. 1 to Mar. 6, 1872.
Mackay, William S.	2d Lt. 3d Inf.	.....	Baton Rouge, La.	July 12 to 31, 1871, and Oct. 31, 1871, to June 30, 1872.
MacNutt, Ira	2d Lt. 3d Art.	.....	Fort Wallace, Kans.	July 1 to Dec. 1, 1871.
Mahnken, J. H.	1st Lt. 8th Cav.	Major.	Presidio, San Francisco, Cal.	July 1, 1871, to June 30, 1872.
Maize, W. R.	1st Lt. 20th Inf.	Captain.	Fort Ransom, Dak.	July 1 to Oct. 1, 1871.
Manley, John A.	1st Lt. 20th Inf.	.....	Fort Snelling, Minn.	Oct. 4, 1871, to June 30, 1872.
Markley, A. C.	1st Lt. 24th Inf.	.....	Fort Lyon, Colo.	Nov. 1, 1871, to June 30, 1872.
Mathey, E. G.	1st Lt. 7th Cav.	.....	Barrancas, Fla.	July 1, 1871, to June 30, 1872.
McCaskey, William S.	1st Lt. & R. Q. M. 20th Inf.	.....	Carlisle Barracks, Pa.	July 1 to 27, 1871.
McCauley, C. A. H.	2d Lt. 3d Art.	.....	Recruiting Rendezvous, N. York City.	Aug. 1, 1871, to June 30, 1872.
McCoy John	1st Lt. 16th Inf.	Major.	Camp Sykes, Dak.	June — to 30, 1872.
McCrea, Tully	Capt. 1st Art.	do.	Fort Ripley, Minn.	April 1 to June 30, 1872.
McDermott, George.	1st Lt. 5th Inf.	.....	Fort McIntosh, Texas.	May 8 to June 30, 1872.
McDermott, George B.	2d Lt. 23d Inf.	.....	Unionville, S. C.	Aug. 3 to Nov. 7, 1871.
McDougall, T. M.	1st Lt. 7th Cav.	.....	Spartanburgh, S. C.	May 15 to June 30, 1872.
McIntyre, A.	2d Lt. 2d Inf.	.....	Fort Snelling, Minn.	July 1 to Oct. 4, 1871.
McNaught, J. S.	Capt. 20th Inf.	.....	Savannah, Ga.	July 1, 1871, to June 30, 1872.
McNutt, John	Maj. Ord.	Colonel.	Aberdeen, Miss.	July 1 to Aug. 7, 1871.
Michaelis, O. E.	1st Lt. Ord.	Captain.	West Point, N. Y.	July 1, 1871, to June 30, 1872.
Miles, Evan	Capt. 20th Inf.	.....	Newport Barracks, Ky.	July 1, 1871, to April 8, 1872.
Miller, James	1st Lt. & R. Q. M. 2d Inf.	.....	Camp Three Forks, Owyhee, Idaho.	July 1 to Aug. 31, 1871.
			Fort Boise, Idaho.	Sept. 4, 1871, to June 30, 1872.
			Spartanburgh, S. C.	July 1 to 31, 1871.
			Unionville, S. C.	Jan. 31 to May 15, 1872.
			Patona, Ala.	July 1 to 31, 1871.
			Chattanooga, Tenn.	Jan. 1 to June 30, 1872.
			Fort Wadsworth, Dak.	June 1 to 30, 1872.
			Columbus arsenal, O.	July 1 to Sept. 1, 1871, and Dec. 3, 1871, to June 30, 1872.
			Watertown arsenal, Mass.	July 1, 1871, to June 30, 1872.
			Fort Colville, Wash.	June 10 to 30, 1872.
			Huntsville, Ala.	July 1, 1871, to Jan. 1, 1872.
			Mobile, Ala.	Jan. 13 to June 30, 1872.

B.—List of officers on duty as acting assistant quartermasters, &c.—Continued.

Name.	Lineal rank and regiment.	Brevet rank.	Station.	Time during year on duty as A. A. Q. M.
Miller, William A.	1st Lt. 18th Inf.	.....	Newberry, S. C.	July 1 to Oct. 23, 1871.
Miller, W. H.	2d Lt. 9th Inf.	.....	Red Willow, Nebr.	May 1 to June 30, 1872.
Miltimore, A. E.	1st Lt. 1st Art.	.....	Madison Barracks, N. Y.	July 1 to Sept. 1, 1871.
Moore, Francis	1st Lt. & R. Q. M. 9th Cav.	.....	Fort Stockton, Tex.	July 1, 1871, to March 31, 1872.
Morgan, A. S. M.	Capt. & O. S. K.	.....	Fort Clark, Tex.	April 21 to June 30, 1872.
Morrison, T. W.	2d Lt. 16th Inf.	.....	Allegheny arsenal, Pa.	May 20 to June 30, 1872.
Morton, Alfred	1st Lt. & R. Q. M. 9th Inf.	.....	Meridian, Miss.	July 1 to Sept. 5, and Nov. 16 to Dec. 9, 1871.
Moss, H. H.	1st Lt. 1st Cav.	.....	Fort D. A. Russell, Wyo.	July 1, 1871, to Jan. 1, 1872, and March 6 to June 30, 1872.
Murdoch, D. H.	1st Lt. 6th Inf.	.....	Fort Klamath, Oreg.	Oct. 31, 1871, to June 30, 1872.
Myers, J. W.	2d Lt. 10th Cav.	.....	Fort Scott, Kans.	July 1 to Oct. 20, 1871.
Nave, A. H.	2d Lt. 7th Cav.	.....	Fort Gibson, G. N.	May 4 to June 14, 1872.
Nelde, Horace	1st Lt. 4th Inf.	Major.	Shelbyville, Ky.	Oct. 10, 1871, to June 30, 1872.
Nelson, William H.	2d Lt. 7th Inf.	.....	Paducah, Ky.	April 5 to June 30, 1872.
Nixon, John B.	1st Lt. & R. Q. M. 24th Inf.	.....	Camp Baker, Mont.	May 15 to June 30, 1872.
Northup, E. B.	1st Lt. 17th Inf.	.....	Fort McKavett, Tex.	July 1, 1871, to June 30, 1872.
Nowlan, H. J.	1st Lt. & R. Q. M. 7th Cav.	.....	Fort Stevenson, Dak.	Oct. 1, 1871, to June 17, 1872.
O'Brien, John J.	2d Lt. 4th Inf.	.....	Louisville, Ky.	April 1 to June 30, 1872.
O'Brien, L. M.	1st Lt. 17th Inf.	.....	Mount Sterling, Ky.	July 1, 1871, to June 30, 1872.
O'Connor, S.	1st Lt. 23d Inf.	.....	Cheyenne Agency, Dak.	Dec. 30, 1871, to June 30, 1872.
Osgood, H. B.	1st Lt. 3d Art.	.....	Camp Crittenden, Ariz.	March 31 to June 30, 1872.
Overton, G. E.	2d Lt. 6th Cav.	.....	Fort Jefferson, Fla.	July 1 to Oct. 20, 1871.
Padfrey, C. F.	2d Lt. 1st Art.	.....	Fort Wallace, Kans.	April 30 to June 30, 1872.
Parker, F. H.	Captain Ord.	Major.	Madison Barracks, N. Y.	Sept. 1, 1871, to June 12, 1872.
Parnell, William R.	1st Lt. 1st Cav.	Major.	Detroit arsenal, Mich.	July 1 to Nov. 7, 1871.
Parry, William W.	1st Lt. 13th Inf.	Lt.-Col.	Camp Harney, Oreg.	Nov. 30, 1871, to June 30, 1872.
Paul, A. C.	2d Lt. 3d Cav.	.....	Camp Douglas, Utah.	July 1 to Sept. 4, 1871.
Paul, C. R.	1st Lt. 18th Inf.	Captain.	Camp Hualpai, Ariz.	July 1 to Oct. 31, and Dec. 1 to 8, 1871.
Penny, C. G.	1st Lt. 6th Inf.	.....	Sumter, S. C.	June 1 to 30, 1872.
Phipps, F. H.	1st Lt. Ord.	.....	Fort Buford, Dak.	June — to 30, 1872.
Pickett, George B.	2d Lt. 16th Inf.	.....	Washington arsenal, D. C.	July 15 to Nov. 6, 1871.
Poland, M. L.	1st Lt. Ord.	Captain.	Aberdeen, Miss.	Sept. 30 to Nov. 20, 1871.
Pollock, Robert	1st Lt. 21st Inf.	.....	Rock Island arsenal, Ill.	July 1 to August 5, 1871.
Pope, John, jr.	2d Lt. 1st Art.	.....	Fort Vancouver, Wash.	Feb. 1 to May 8, 1872.
Porter, James E.	2d Lt. 7th Cav.	.....	Fort Wood, New York Harbor.	April 30 to June 30, 1872.
Pratt, H. C.	1st Lt. 13th Inf.	Captain.	Lincolnton, N. C.	March 14 to June 30, 1872.
Price, G. F.	1st Lt. 5th Cav.	.....	Camp Brown, Wyo.	July 1 to Oct. 20, 1871.
Prince, William	1st Lt. Ord.	.....	Camp McDowell, Ariz.	June — to 30, 1872.
Pullman, J. W.	2d Lt. 8th Cav.	.....	Frankford arsenal, Pa.	July 1, 1871, to June 30, 1872.
Quimby, H. B.	1st Lt. & R. Q. M. 25th Inf.	.....	Camp at old Fort Lowell, N. M.	May 17 to June 30, 1872.
Quimby, Ira.	1st Lt. & R. Q. M. 11th Inf.	.....	Fort Clark, Tex.	July 1, 1871, to April 21, 1872.
Quinn, Thomas F.	1st Lt. 4th Inf.	Captain.	Fort Davis, Tex.	May 31 to June 30, 1872.
Randall, E. L.	1st Lt. 5th Inf.	.....	Fort Griffin, Tex.	Aug. 3, 1871, to March 8, 1872.
Raphall, A. M.	2d Lt. 11th Inf.	.....	Frankfort, Ky.	July 1, 1871, to May 1, 1872.
Rawdle, W. C.	1st Lt. & R. Q. M. 2d Cav.	.....	Fort Harker, Kans.	July 1, 1871, to June 30, 1872.
Reed, H. A.	2d Lt. 2d Art.	.....	Fort Concho, Tex.	July 9, 1871, to April 8, 1872.
Reedy, W. J.	1st Lt. 22d Inf.	.....	Omaha Barracks, Nebr.	July 1, 1871, to June 30, 1872.
Regan, James	1st Lt. 9th Inf.	.....	Camp McDermit, Nev.	July 1 to Oct. 1, 1871, and Dec. 1, 1871, to March 10, 1872.
Reilly, James W.	1st Lt. Ord.	Captain.	Fort Randall, Dak.	July 1 to Aug. 1, 1871.
Rexford, William H.	Capt. & O. S. K.	.....	Lower Brulé Agency, Dak.	Aug. 13, 1871, to June 30, 1872.
Rheem, E. B.	2d Lt. 21st Inf.	.....	Fort Kearney, Nebr.	Oct. 1 to Nov. 16, 1871.
Rice, William F.	1st Lt. 23d Inf.	.....	Watervliet arsenal, N. Y.	July 1 to 31, 1871.
Richards, William V.	1st Lt. & R. Q. M. 16th Inf.	Captain.	Mount Vernon arsenal, Ala.	July 1, 1871, to June 30, 1872.
Roberts, C.	1st Lt. 17th Inf.	.....	Fort Whipple, Ariz.	July 1, 1871, to April 30, 1872.
		.....	Fort Colville, Wash.	July 1, 1871, to June 10, 1872.
		.....	Nashville, Tenn.	July 1, 1871, to June 30, 1872.
		.....	Fort Stevenson, Dak.	July 1, 1871, to Sept. 30, 1871.

B.—List of officers on duty as acting assistant quartermasters, &c.—Continued.

Name.	Lineal rank and regiment.	Brevet rank.	Station.	Time during year on duty as A. A. Q. M.
Robinson, Frederick.	1st Lt. 5th Art.	Captain.	Fort Independence, Mass.	July 1, 1871, to March 31, 1872.
Robinson, F. U.	2d Lt. 2d Cav.		Camp Stambaugh, Wyo.	Oct. 8, 1871, to June 30, 1872.
Robinson, Thomas B.	1st Lt. 19th Inf.		Fort Jackson, La.	July 1 to Nov. 30, 1871.
			Little Rock, Ark.	Dec. 19, 1871, to June 30, 1872.
Robinson, W. W., jr.	2d Lt. 3d Cav.		In the field, Ariz.	Aug. 15 to Nov. 18, 1871.
Rockwell, C. H.	2d Lt. 5th Cav.		Camp Grant, Ariz.	Jan. 31 to June 30, 1872.
Rodgers, C. P.	1st Lt. 5th Cav.		Cavalry Depot, Saint Louis, Mo.	Aug. 31, 1871, to June 30, 1872.
Rogers, B. H.	1st Lt. 13th Inf.		Fort Bridger, Wyo.	July 1, 1871, to June 30, 1872.
Rogers, J. S.	2d Lt. 1st Inf.		Fort Wayne Mich.	June 1 to 30, 1872.
Rogers, William P.	2d Lt. 17th Inf.		Cheyenne Agency, Dak.	July 1, 1871, to Dec. 20, 1871.
Rogers, W. W.	1st Lt. 9th Inf.		Sidney Barracks, Nebr.	May 5 to June 30, 1872.
Rollins, James H.	Captain Ord.		Augusta Arsenal, Ga.	July 1, 1871, to June 30, 1872.
Romeyn, Henry	1st Lt. 5th Inf.	Captain.	Fort Scott, Kans.	Oct. 20, 1871, to June 30, 1872.
Ropes, James M.	1st Lt. 8th Cav.		Fort Garland, Col.	July 1, 1871, to May 17, 1872.
Rosencrantz, Fred'k.	1st Lt. 16th Inf.		Aberdeen, Miss.	Nov. 20, 1871, to June 30, 1872.
Ross, John M.	2d Lt. 21st Inf.		Camp Pinal, Ariz.	July 1 to Aug. 31, 1871.
Rosa, William J.	2d Lt. 21st Inf.		In the field, Ariz.	July 1, 1871, to June 30, 1872.
Rutherford, R. G.	2d Lt. 12th Inf.	Captain.	Fort Columbus, N. Y. Harbor.	July 1, 1871, to June 30, 1872.
Ryan, E. T.	2d Lt. 15th Inf.		Fort Cummings, N. Mex.	July 1, 1871, to Jan. 3, 1872.
Sage, George E.	2d Lt. 5th Art.		Fort Independence, Mass.	April 1 to June 30, 1872.
Sanbourne, M. C.	2d Lt. 7th Inf.	Captain.	Camp Baker, Mon.	Oct. 21, 1871, to May 15, 1872.
Sands, J. H.	1st Lt. 6th Cav.		Camp near Fort Hays, Kans.	May 27 to June 30, 1872.
Sarson, H. B.	2d Lt. 2d Inf.		Huntsville, Ala.	Jan. 31 to June 30, 1872.
Saxton, M. W.	2d Lt. 24th Inf.		Fort Quitman, Tex.	Oct. 15, 1871, to June 30, 1872.
Schenck, A. D.	2d Lt. 2d Art.		Camp Tulare, Cal.	July 10 to 24, 1871.
			En route to San Francisco, Cal.	July 24 to Aug. 4, 1871.
Schwatka, Fred.	2d Lt. 3d Cav.		North Platte, Nebr.	April 30 to June 30, 1872.
Scott, John	2d Lt. 4th Inf.		Mount Vernon, Ky.	July 1 to Oct. 9, 1871.
			Crab Orchard, Ky.	Oct. 10, 1871, to June 30, 1872.
Sellmer, Charles	2d Lt. 3d Art.	Captain.	Fort Pulaski, Ga.	June 1 to 30, 1872.
Sharp, Thomas	1st Lt. 1st Inf.		Fort Mackinac, Mich.	July 1, 1871, to June 30, 1872.
Sheets, J. A.	1st Lt. 4th Inf.	Major.	Lebanon, Ky.	July 1, 1871, to May 6, 1872.
Shelby, Isaac O.	2d Lt. 16th Inf.		Vicksburg and Natchez, Miss.	July 1, 1871, to June 30, 1872.
Sheldon, George W.	1st Lt. 4th Art.		Rutherfordton, N. C.	Jan. 1 to Mar. 31, 1872.
Shelton, E. H.	2d Lt. 1st Cav.		Fort Lapwai, Idaho.	Dec. 1, 1871, to June 30, 1872.
Sherman, H. P.	2d Lt. 15th Inf.		Fort Cummings, N. Mex.	Feb. 14 to May 16, 1872.
Sherman, James L.	1st Lt. 1st Art.		Fort Niagara, N. Y.	Jan. 9 to June 30, 1872.
Sherwood, William L.	2d Lt. 21st Inf.		Camp Crittenden, Ariz.	July 1, 1871, to Feb. 29, 1872.
Shookley, George	Capt. 15th Inf.		Fort McKee, N. Mex.	Dec. 13, 1871, to June 30, 1872.
Silva, V. M. C.	1st Lt. 21st Inf.		Yuma Depot, Ariz.	Oct. 18, 1871, to Jan. 29, 1872.
			Fort Vancouver, Wash.	May 8 to June 30, 1872.
Slade, Charles E.	2d Lt. 15th Inf.		Fort Stanton, N. Mex.	Oct. 1, 1871, to June 30, 1872.
Smallwood, J. H.	2d Lt. 2d Cav.		Fort Kearney, Nebr.	July 1 to Sept. 30, and Nov. 16 to 28, 1871.
Smith, A. E.	1st Lt. 7th Cav.	Captain.	Elizabethtown, Ky.	July 1, 1871, to Jan. 8, 1872.
Smith, H. M.	Capt. 21st Inf.		Camp Bowie, Ariz.	Jan. 1 to Feb. 16, 1872.
Smith, Lewis	1st Lt. & R. Q. M. 3d Art.		Charleston, S. C.	July 1, 1871, to June 30, 1872.
Spurgin, William F.	1st Lt. 21st Inf.		San Diego, Cal.	July 1 to 12, 1871.
			Camp Crittenden, Ariz.	Feb. 29 to Mar. 31, 1872.
Stafford, J. S.	1st Lt. 20th Inf.		Fort Ransom, Dak.	Oct. 1 to 31, 1871, and April 1 to June 30, 1872.
Stansbury, H. E.	Capt. 19th Inf.		Little Rock, Ark.	Oct. 15 to Dec. 19, 1871.
Starr, Irwin M.	1st Lt. 9th Cav.		Fort Duncan, Tex.	April 1 to June 30, 1872.
Steele, George W.	1st Lt. & R. Q. M. 14th Inf.		Fort Laramie, Wyo.	July 1, 1871, to June 30, 1872.
Steelhammer, Chas.	Capt. 15th Inf.		Fort Bayard, N. Mex.	July 1, 1871, to Jan. 31, 1872.
			Fort Cummings, N. Mex.	May 16 to June 30, 1872.
Stewart, William F.	1st Lt. 4th Art.		Raleigh, N. C.	Sept. 21, 1871, to Apr. 30, 1872.
Stillé, L. R.	1st Lt. 23d Inf.		Fort Lapwai, Idaho.	July 1 to Nov. 30, 1871.
Stone, E. W.	1st Lt. 21st Inf.	Lt.-Col.	Drum Barracks, Cal.	Sept. 1, 1871, to Jan. 31, 1872.
Styer, Charles	Capt., Asst Surg.		Fort Selden, N. Mex.	July 1 to 31, 1871.
Taylor, A. C.	1st Lt. 2d Art.		Sitka, Alaska.	July 1, 1871, to May 31, 1872.
Taylor, Frank	2d Lt. 14th Inf.		Fort Fetterman, Wyo.	July 1, 1871, to June 30, 1872.
Taylor, George McM.	1st Lt. 23d Inf.		Fort Boise, Idaho.	July 1 to Sept. 4, 1871.
Taylor, S. W.	2d Lt. 4th Art.		Rutherfordton, N. C.	Sept. 4 to Dec. 31, 1871, and April 1 to June 30, 1872.
Theller, E. R.	1st Lt. 21st Inf.		Camp Hualpai, Ariz.	Dec. 8, 1871, to June 30, 1872.
Thibaut, F. W.	1st Lt. 6th Inf.		Fort Smith, Ark.	July 1 to Sept. 30, 1871.

B.—List of officers on duty as acting assistant quartermasters, &c.—Continued.

Name.	Lineal rank and regiment.	Brevet rank.	Station.	Time during year on duty as A. A. Q. M.
Thomas, Evan	Capt. 4th Art. ....	.....	Charlotte, N. C.	Dec. 11, 1871, to Mar. 18, 1872.
Thompson, John C.	1st Lt. & R. Q. ....	.....	Camp Verde, Arizona.	July 1 to December 4, 1871.
	M. 3d Cav. ....	.....	Fort McPherson, Neb.	March 31 to June 30, 1872.
Thompson, R. E.	2d Lt. 6th Inf. ....	.....	Fort Stevenson, Dak.	June 17 to June 30, 1872.
Thompson, William	Capt. 7th Cav.	Lt. Col.	Unionville, S. C.	July 25 to August 3, 1871.
Thorne, P. M.	1st Lt. 23d Inf. ....	.....	Fort Sully, Dakota.	Sept. 22, 1871, to Apr. 30, 1872.
Todd, John W.	Major Ord. ....	.....	Detroit Arsenal, Mich.	Nov. 7, 1871, to June 30, 1872.
Trout, John F.	1st Lt. 23d Inf. ....	.....	Camp Warner, Oregon.	July 1, 1871, to Aug. 24, 1871.
Tyler, John.	1st Lt. & R. Q.	Major.	Fort Wayne, Mich.	July 1, 1871, to June 1, 1872.
	M. 1st Inf. ....	.....	Buffalo, N. Y.	June 1 to 30, 1872.
Upham, F. K.	1st Lt. 1st Cav. ....	.....	Camp Apache, Ariz.	Aug. 1, 1871, to June 30, 1872.
Van Horn, Wm. M.	1st Lt. & R. Q. ....	.....	Fort Rice, Dakota.	July 1, 1871, to May 29, 1872.
	M. 17th Inf. ....	.....	
Vedder, S. C.	2d Lt. 19th Inf. ....	.....	Jackson Barracks, New Orleans, La.	July 1, 1871, to June 30, 1872.
Vogdes, A. W.	1st Lt. 4th Inf. ....	.....	Lexington, Ky.	December 12 to 24, 1871.
Vose, William P.	1st Lt. 2d Cav.	Captain.	Point San Jose, Cal.	January 17 to June 30, 1872.
Walker, John P.	1st Lt. 3d Cav. ....	.....	Camp Huapai, Ariz.	Oct. 31 to Nov. 30, 1871.
Walker, Mark	1st Lt. 19th Inf.	Captain.	Baton Rouge, La.	July 1 to 12 and Aug. 1 to 31, 1871.
				Aug. 7 to Sept. 30, 1871.
Wallace, W. M.	1st Lt. 6th Cav. ....	.....	Aberdeen, Miss.	July 1 1871, to Feb. 4, 1872.
Walton, John M.	2d Lt. & R. Q. ....	.....	Fort Richardson, Tex.	
	M. 4th Cav. ....	.....	
Ward, E. W.	1st Lt. 5th Cav. ....	.....	Cav. depot, St. Louis, Missouri.	— to Aug. 10, 1871.
Ward, F. K.	1st Lt. 1st Cav. ....	.....	Camp Harney, Oregon.	July 1 to Oct. 21, 1871.
Ward, H. C.	1st Lt. 16th Inf.	Captain.	Tallahassee, Fla.	July 4 and 5, 1871.
Webster, Isaac T.	1st Lt. 1st Art. ....	.....	San Augustine, Fla.	July 5, 1871, to June 30, 1872.
Wesendorff, Max	1st Lt. 1st Cav. ....	.....	Fort Wood, N. Y. H.	Aug. 1, 1871, to April 30, 1872.
			In the field, Arizona.	July 1 to Sept. 10, 1871.
Wessels, H. W. jr.	1st Lt. 3d Cav. ....	.....	Fort Whipple, Ariz.	May 1 to June 30, 1872.
Weston, John F.	1st Lt. & R. Q. ....	.....	Camp McDowell, Ariz.	July 1 to Aug. 15, 1871.
	M. 7th Cav. ....	.....	Louisville, Ky.	July 1, 1871, to Feb. 29, 1872.
Whitall, S. R.	2d Lt. 16th Inf. ....	.....	Humboldt, Tenn.	Aug. 11, 1871, to June 30, 1872.
Whitehead, F. F.	1st Lt. 18th Inf.	Major.	Yorkville, S. C.	July 1, 1871, to June 30, 1872.
Whitman, R. E.	1st Lt. 3d Cav. ....	.....	Camp Grant, Ariz.	July 1, 1871, to Jan. 31, 1872.
Whitmore, J. M.	Capt. Ord. ....	.....	Kennebec arsenal, Me.	July 1, 1871, to June 30, 1872.
Willey, Thomas M.	2d Lt. 6th Inf. ....	.....	Newport, on Mo. River.	— to June 30, 1872.
Williams, W. M.	2d Lt. 19th Inf. ....	.....	Holly Springs, Miss.	Dec. 29, 1871, to June 30, 1872.
Wilson, D. B.	1st Lt. 25th Inf. ....	.....	Fort Stockton, Texas.	June 1 to 30, 1872.
Wilson, George S.	2d Lt. 13th Inf. ....	.....	Fort Hall, Idaho.	July 1, 1871, to Mar. 31, 1872.
Winters, William H.	1st Lt. 1st Cav. ....	.....	Camp Bidwell, Cal.	Sept. 1, 1871, to June 30, 1872.
Wishart, Alexander.	1st Lt. 20th Inf.	Captain.	Fort Wadsworth, Dak.	Jan. 31 to May 31, 1872.
			Newport, James River, Dakota.	June 3 to 30, 1872.
Wood, O. E.	1st Lt. 5th Art. ....	.....	Fort Sullivan, Me.	July 1, 1871, to June 30, 1872.
Wood, W. W.	2d Lt. 20th Inf. ....	.....	Fort Totten, Dakota.	July 1 to 31, 1871.
Woodruff, Thomas M.	2d Lt. 5th Inf. ....	.....	Drywood Camp, Kans.	June 26 to 30, 1872.
Worden, John L.	1st Lt. 1st Inf. ....	.....	Madison Bar'ks, N. Y.	June 12 to 30, 1872.

C.—Stations and duties of officers of the Quartermaster's Department, July 1, 1872.

I.

QUARTERMASTER-GENERAL.

Meigs, Brevet Major-General M. C., Washington, D. C.

COLONELS AND ASSISTANT QUARTERMASTER-GENERALS.

Allen, Brevet Major-General Robert, Quartermaster-General's Office, Washington, D. C.

Rucker, Brevet Major-General Daniel H., chief quartermaster Military Division of the Missouri, and in charge of depot, Chicago, Illinois.

Ingalls, Brevet Major-General Rufus, in charge of depot, and chief quartermaster Department of the East, New York City.

Easton, Brevet Major-General Langdon C., chief quartermaster Military Division of the Atlantic, in charge of depot and Schuylkill arsenal, Philadelphia, Pennsylvania.

Van Vliet, Brevet Major-General Stewart, chief quartermaster Department of the Missouri, Fort Leavenworth, Kansas, on leave of absence.

LIEUTENANT-COLONELS AND DEPUTY QUARTERMASTER-GENERALS.

Holabird, Brevet Brigadier-General Samuel B., chief quartermaster Department of Texas, San Antonio, Texas.

Tyler, Brevet Major-General Robert O., chief quartermaster Military Division of the Pacific, San Francisco, California.

Tompkins, Brevet Brigadier-General Charles H., chief quartermaster Department of Dakota, Saint Paul, Minnesota.

Ekin, Brevet Brigadier-General James A., chief quartermaster Department of the South, Louisville, Kentucky.

Myers, Brevet Brigadier-General Frederick, chief quartermaster District of New Mexico, Santa Fé, New Mexico.

Ransom, Hyatt C., quartermaster District of Montana, and post quartermaster Fort Shaw, Montana Territory.

Eddy, Brevet Colonel Asher R., chief quartermaster third quartermaster's district, Department of the East, Philadelphia, Pennsylvania.

Saxton, Brevet Brigadier-General Rufus, chief quartermaster Department of the Columbia, Portland, Oregon.

MAJORS AND QUARTERMASTERS.

Montgomery, Alexander, chief quartermaster second quartermaster's district, Department of the East, Boston, Massachusetts.

Moore, Brevet Brigadier-General Tredwell, post quartermaster Fort Adams, Rhode Island.

Bingham, Brevet Brigadier-General Judson D., Quartermaster-General's Office, Washington, D. C.

Perry, Brevet Brigadier-General Alexander J., chief quartermaster Department of the Platte, Omaha, Nebraska.

Hodges, Brevet Lieutenant-Colonel Henry C., closing accounts, Philadelphia, Pennsylvania.

Chandler, Brevet Colonel John G., in charge of depot, and acting chief quartermaster Department of the Missouri, Fort Leavenworth, Kansas.

Sawtelle, Brevet Brigadier-General Charles G., chief quartermaster Department of California, and in charge of depot, San Francisco, California.

Dana, Brevet Brigadier-General James J., chief quartermaster Department of Arizona, Prescott, Arizona Territory.

Potter, Brevet Brigadier-General Joseph A., chief quartermaster Department of the Lakes, Detroit, Michigan.

Batchelder, Brevet Colonel Richard N., chief quartermaster first quartermaster's district, Department of the East, New York City.

Ludington, Brevet Lieutenant-Colonel Marshall I., Quartermaster-General's Office, Washington, D. C.

Moore, Brevet Lieutenant-Colonel James M., closing accounts, Fort Leavenworth, Kansas.

Belger, James, quartermaster, Galveston, Texas.

Myers, Brevet Brigadier-General William, in charge of depot, Washington, D. C.

Enos, Brevet Colonel Herbert M., on sick leave, Waukesha, Wisconsin.

Card, Brevet Brigadier-General Benjamin C., in charge of depot, San Antonio, Texas.

CAPTAINS AND ASSISTANT QUARTERMASTERS.

Reynolds, Brevet Lieutenant Colonel Charles A., in charge of depot, Cheyenne, Wyoming Territory.

Dandy, Brevet Brigadier-General George B., Fort Abercrombie, Dakota Territory.

Weeks, Brevet Lieutenant-Colonel George H., under orders to report in person to the Quartermaster-General.

Carling, Brevet Lieutenant-Colonel Elias B., Fort Monroe, Virginia.

Hughes, William B., chief quartermaster Department of the Gulf, New Orleans, Louisiana.

Robinson, Brevet Major Augustus G., *en route* changing station from Fort Hays, Kansas, to Fort Sill, Indian Territory.

Baker, Edward D., Salt Lake City, Utah Territory.

James, Brevet Lieutenant-Colonel Henry W., in charge of depot, Fort Vancouver, Washington Territory.

Inman, Brevet Lieutenant-Colonel Henry, awaiting orders, Fort Abercrombie, Dakota Territory.

Lee, Brevet Lieutenant-Colonel James G. C., in charge of depot, Yuma depot, Arizona Territory.

Gilliss, James, Chicago, Illinois.

Eckerson, Brevet Major Theodore J., awaiting orders, Chester, Pennsylvania.

McGonnigle, Brevet Colonel Andrew J., in charge of depot, Fort Union, New Mexico.

Grimes, Brevet Major Edward B., in charge of depot, Saint Louis, Missouri.

Scully, Brevet Colonel James W., Fort Rice, Dakota Territory.

Howell, Brevet Major William T., Fort Griffin, Texas.

Foster, Brevet Colonel Charles W., Sioux City, Iowa.

Bradley, George W., in charge of depot, Charleston, South Carolina.

Barstow, Brevet Lieutenant-Colonel Simon F., on duty as aid-de-camp, headquarters Military Division of the Atlantic, Philadelphia, Pennsylvania.

Belcher, Brevet Major John H., in charge of depot, Omaha, Nebraska.

Kirk, Ezra B., Camp Supply, Indian Territory.

Kimball, Amos S., Fort Riley, Kansas.

Rockwell, Brevet Lieutenant-Colonel Almon F., Fort Sill, Indian Territory.

Smith, Gilbert C., San Francisco, California.

Hunt, Brevet Lieutenant-Colonel Thomas B., awaiting orders, San Antonio, Texas.

Strang, Brevet Lieutenant-Colonel Edward J., Brownsville, Texas.

Constable, Nathaniel S., Fort Concho, Texas.

Furey, John V., Tucson, Arizona Territory.

Forsyth, Brevet Major Lewis C., Fort Ellis, Montana Territory.

Hoyt, Charles H., in charge of depot, Jeffersonville, Indiana.

Blunt, Brevet Colonel Asa P., on leave of absence.

CAPTAINS AND MILITARY STORE-KEEPERS.

Potter, Reuben M., acting assistant quartermaster, Pittsburgh, Pennsylvania.

Allgood, Charles A., acting assistant quartermaster, Baltimore, Maryland.

Rodgers, John F., Jeffersonville, Indiana.

Hull, Gustavus A., acting assistant quartermaster, Fort Sanders, Wyoming Territory.

Dimpfel, George H. A., settling accounts, San Francisco, California.

Sawyer, Nathan D. A., acting assistant quartermaster, Victoria, Texas.

Livers, John, Fort Leavenworth, Kansas.

Lieber, Hamilton, Fort Snelling, Minnesota.

Van Antwerp, Verplanck, Philadelphia, Pennsylvania.

Barrett, Addison, acting assistant quartermaster, Yerba Buena Island, California.

Martin, William P., acting assistant quartermaster, Columbia, South Carolina.

II.

QUARTERMASTER-GENERAL'S OFFICE.

Meigs, Brevet Major-General Montgomery C., Quartermaster-General; Allen, Brevet Major-General Robert, assistant quartermaster-general; Bingham, Brevet Brigadier-General Judson D., quartermaster; Ludington, Brevet Lieutenant-Colonel Marshall I., quartermaster.

GENERAL DEPOTS ESTABLISHED BY GENERAL ORDERS NO. 32, HEADQUARTERS ARMY, APRIL 8, 1869.

New York.—Ingalls, Brevet Major-General Rufus, assistant quartermaster-general in charge.

Philadelphia and Schuylkill Arsenal, Pennsylvania.—Easton, Brevet Major-General Langdon C., assistant quartermaster-general, in charge; Van Antwerp, Captain Verplanck, military store-keeper.

Washington, D. C.—Myers, Brevet Brigadier-General William, quartermaster, in charge.

Jeffersonville, Indiana.—Hoyt, Captain Charles H., assistant quartermaster, in charge; Rodgers, Captain John F., military storekeeper.

MILITARY DIVISION OF THE ATLANTIC.

Headquarters, Philadelphia, Pennsylvania.—Easton, Brevet Major-General Langdon C., assistant quartermaster-general, chief quartermaster.

Department of the East, headquarters, New York City.—Ingalls, Brevet Major-General Rufus, assistant quartermaster-general, chief quartermaster; Eddy, Brevet Colonel Asher R., deputy quartermaster-general, Philadelphia, Pennsylvania; Montgomery, Major Alexander, quartermaster, Boston, Massachusetts; Moore, Brevet Brigadier-General Tredwell, quartermaster, Fort Adams, Rhode Island; Hodges, Brevet Lieutenant-Colonel Henry C., quartermaster, settling accounts, Philadelphia, Pennsylvania;

Batchelder, Brevet Colonel Richard N., quartermaster, New York City; Carling, Brevet Lieutenant-Colonel Elias B., assistant quartermaster, Fort Monroe, Virginia; Potter, Captain Reuben M., military store-keeper, Pittsburgh, Pennsylvania; Allgood, Captain Charles A., military store-keeper, Baltimore, Maryland.

Department of the Lakes, headquarters, Detroit, Michigan.—Potter, Brevet Brigadier-General Joseph A., quartermaster, chief quartermaster.

MILITARY DIVISION OF THE MISSOURI.

Headquarters, Chicago, Illinois.—Rucker, Brevet Major-General Daniel H., assistant quartermaster-general, chief quartermaster; Grimes, Brevet Major Edward B., assistant quartermaster, Saint Louis, Missouri; Gilliss, Captain James, assistant quartermaster, Chicago, Illinois.

Department of the Missouri, headquarters, Fort Leavenworth, Kansas.—Van Vliet, Brevet Major-General Stewart, assistant quartermaster-general, chief quartermaster, on leave of absence; Myers, Brevet Brigadier-General Frederick, deputy quartermaster-general, Santa Fé, New Mexico; Chandler, Brevet Colonel John G., quartermaster, Fort Leavenworth, Kansas; Moore, Brevet Lieutenant-Colonel James M., quartermaster, settling accounts, Fort Leavenworth, Kansas; Robinson, Brevet Major Augustus G., assistant quartermaster, en route from Fort Hays, Kansas, to Fort Sill, Indian Territory; McGonnigle, Brevet Colonel Andrew J., assistant quartermaster, Fort Union, New Mexico; Kirk, Captain Ezra B., assistant quartermaster, Camp Supply, Indian Territory; Kimball, Captain Amos S., assistant quartermaster, Fort Riley, Kansas; Livers, Captain John, military store-keeper, Fort Leavenworth, Kansas.

Department of the Platte, headquarters, Omaha, Nebraska.—Perry, Brevet Brigadier-General Alexander J., quartermaster, chief quartermaster; Reynolds, Brevet Lieutenant-Colonel Charles A., assistant quartermaster, Cheyenne, Wyoming Territory; Baker, Captain Edward D., assistant quartermaster, Salt Lake City, Utah Territory; Belcher, Brevet Major John H., assistant quartermaster, Omaha, Nebraska; Hull, Captain Gustavus A., military store-keeper, Fort Sanders, Wyoming Territory.

Department of Dakota, headquarters, Saint Paul, Minnesota.—Tompkins, Brevet Brigadier-General Charles H., deputy quartermaster-general, chief quartermaster; Ransom, Lieutenant-Colonel Hyatt C., deputy quartermaster-general, Fort Shaw, Montana Territory; Dandy, Brevet Brigadier-General George B., assistant quartermaster, Fort Abercrombie, Dakota Territory; Inman, Brevet Lieutenant-Colonel Henry, assistant quartermaster, awaiting orders, Fort Abercrombie, Dakota Territory; Scully, Brevet Colonel James W., assistant quartermaster, Fort Rice, Dakota Territory; Foster, Brevet Colonel Charles W., assistant quartermaster, Sioux City, Iowa; Forsyth, Brevet Major Lewis C., assistant quartermaster, Fort Ellis, Montana Territory; Lieber, Captain Hamilton, military store-keeper, Fort Snelling, Minnesota.

Department of Texas, headquarters, San Antonio, Texas.—Holabird, Brevet Brigadier-General S. B., deputy quartermaster-general, chief quartermaster; Belger, Major James, quartermaster, Galveston, Texas; Card, Brevet Brigadier-General Benjamin C., quartermaster, San Antonio, Texas; Howell, Brevet Major William T., assistant quartermaster, Fort Griffin, Texas; Rockwell, Brevet Lieutenant-Colonel, Almon F., assistant quartermaster, Fort Sill, Indian Territory; Hunt, Brevet Lieutenant-Colonel Thomas B., assistant quartermaster, awaiting orders, San Antonio, Texas; Strang, Brevet Lieutenant-Colonel Edward J., assistant quartermaster, Brownsville, Texas; Constable, Captain Nathaniel S., assistant quartermaster, Fort Concho, Texas; Sawyer, Captain Nathan D. A., military store-keeper, Victoria, Texas.

MILITARY DIVISION OF THE PACIFIC.

Headquarters, San Francisco, California.—Tyler, Brevet Major-General Robert O., deputy quartermaster-general, chief quartermaster; Dimpfel, Captain George H. A., military store-keeper, awaiting orders, San Francisco, California.

Department of California, headquarters, San Francisco, California.—Sawtelle, Brevet Brigadier-General Charles G., quartermaster, chief quartermaster; Smith, Captain Gilbert C., assistant quartermaster, San Francisco, California; Barrett, Captain Addison, military store-keeper, Yerba Buena Island, California.

Department of Arizona, headquarters, Prescott, Arizona Territory.—Dana, Brevet Brigadier-General James J., quartermaster, chief quartermaster; Lee, Brevet Lieutenant-Colonel James G. C., assistant quartermaster, Yuma depot, Arizona Territory; Furey, Captain John V., assistant quartermaster, Tucson, Arizona Territory.

Department of the Columbia, headquarters, Portland, Oregon.—Saxton, Brevet Brigadier-General Rufus, deputy quartermaster-general, chief quartermaster; Jones, Brevet Lieutenant-Colonel Henry W., assistant quartermaster, Fort Vancouver, Washington Territory.

DEPARTMENT OF THE SOUTH.

Headquarters, Louisville, Kentucky.—Ekin, Brevet Brigadier-General James A., deputy quartermaster-general, chief quartermaster; Bradley, Captain George W., assistant quartermaster, Charleston, South Carolina; Martin, Captain William F., military store-keeper, Columbia, South Carolina.

DEPARTMENT OF THE GULF.

Headquarters, New Orleans, Louisiana.—Hughes, Captain William B., chief quartermaster.

MISCELLANEOUS.

Enos, Brevet Colonel Herbert M., quartermaster, on sick-leave, Waukesha, Wisconsin; Weeks, Brevet Lieutenant-Colonel George H., assistant quartermaster, under orders to report in person to the Quartermaster-General; Eckerson, Brevet Major Theodore J., assistant quartermaster, awaiting orders, Chester, Pennsylvania; Barstow, Brevet Lieutenant-Colonel Simon F., assistant quartermaster, on duty as aid-de-camp at headquarters Military Division of the Atlantic, Philadelphia, Pennsylvania; Blunt, Brevet Colonel Asa P., assistant quartermaster, on leave of absence.

2.—*Report of Major J. D. Bingham, quartermaster U. S. A.*

QUARTERMASTER-GENERAL'S OFFICE,
Washington, D. C., September 27, 1872.

GENERAL: I have the honor to submit the following report of the accounts branch of this office for the last fiscal year:

Appropriations for periods prior to July 1, 1870.

On July 1, 1871, the balance of appropriations of the Quartermaster's Department in the Treasury for years prior to July 1, 1870, undrawn, was, by report of last year	\$898, 016 27
Amount placed to the credit of appropriations by deposits, derived principally from sales during the year of public property purchased from appropriations of former years	2, 467, 633 61
Add sums which, having been expended by this Department, have been refunded by other Departments	215, 879 51
Total	3, 581, 529 39
Requisitions on account of settlements made at the Treasury of claims and accounts	1, 291, 364 68
Balance to credit of appropriations for periods prior to July 1, 1870, remaining in Treasury on 30th June, 1872	2, 290, 164 71

Appropriations for the fiscal year ended June 30, 1871.

Amount placed to the credit of appropriations by deposits, derived principally from sales during the year of public property purchased within the year ending June 30, 1871	\$333, 493 91
Add sums which, having been expended by this Department, have been refunded by other Departments	12, 223 47
Total	345, 717 38
Requisitions on account of settlements made at the Treasury of claims and accounts	72, 855 13
Balance to credit of appropriations for the year ended 30th of June, 1871, remaining in Treasury 30th June, 1872	272, 862 25

Appropriations for the fiscal year ended June 30, 1872.

Appropriations for the fiscal year ended June 30, 1872, act of Congress approved March 3, 1871	\$11,055,000 00
Appropriations for deficiencies, act of Congress approved May 18, 1872.	1,450,000 00
Amount placed to the credit of appropriations by deposits, derived principally from sales during the year of public property purchased within the year ended June 30, 1872	110,804 46
Add sums which, having been expended by this Department, have been refunded by other Departments	1,680 30
Total	12,617,484 76
Remittances to officers for disbursements on requests of the Quartermaster-General	\$12,238,169 09
Requisitions by the Secretary of War on requests of the Ordnance Department	20,800 00
Requisitions on account of settlements made at the Treasury of claims and accounts	258,652 28
	12,517,621 37
Balance of appropriations for the fiscal year ended June 30, 1872, remaining in the Treasury 30th June, 1872	99,863 39
The accounts and vouchers which have passed the administrative examination of this office and been transmitted to the Treasury for final examination and settlement since the last annual report show disbursements from appropriations of years prior to the fiscal year ended June 30, 1872, amounting to	\$35,256,492 42
In the fiscal year ending June 30, 1872	4,532,361 69
Total	39,788,854 11

Appropriations are charged with these disbursements as follows :

1. Appropriations for the Quartermaster's Department, viz :

Regular supplies	\$14,300,023 72
Incidental expenses	4,061,144 77
Purchase of cavalry and artillery horses	903,226 81
Barracks and quarters	6,633,339 40
Army transportation	11,712,509 35
Mileage, transportation of officers' baggage	549,711 68
Material for and amount expended in the purchase and preparation of clothing, camp and garrison equipment	727,558 25
Purchase of stoves	225,869 61
National cemeteries	597,811 56
	\$39,711,195 15

2. Special appropriations and expenditures for other Departments, viz :

Pay Department	14,061 22
Medical Department	5,589 40
Ordnance Department	1,361 47
Navy Department	440 31
Indian Department	34,842 55
Subsistence Department	381 51
Army contingencies	11,003 14
Military telegraphs	5,410 01
United States Military Academy	1,717 28
Recruiting service	55 15
Reconstruction service	1,642 90
Bureau of Refugees, Freedmen and Abandoned Lands	1,069 62
Care, &c., of sick and disabled soldiers	84 40
	77,658 96

Total disbursements exhibited by the accounts examined during the year	39,788,854 11
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The following tables exhibit the number of money-accounts and property-returns on hand at the commencement of the fiscal year, the number received and examined during the year, and the number remaining on hand, unexamined, at the close of the year:

Money-accounts.

	For what calendar year.										Total.
	1862.	1863.	1864.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	
On hand July 1, 1871.....						209	2,000	2,745	1,224		6,178
Received during the year.....	1	6	3	2	1	38	2	25	1,845	1,186	3,109
Total.....	1	6	3	2	1	247	2,002	2,770	3,069	1,186	9,287
Examined during the year.....	1	6	3	2	1	247	2,002	2,770	827	1	5,860
On hand, unexamined, July 1, 1872.....									2,242	1,185	3,427

Property-returns.

	For what calendar year.											
	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	Total.
On hand July 1, 1871.....							318	3,239	4,170	1,105	.....	8,832
Received during the year.....	6	24	25	8	1	4	8	57	25	2,541	821	3,590
Total.....	6	24	25	8	1	4	396	3,296	4,195	3,646	821	12,352
Examined during the year.....	6	24	25	8	1	4	396	3,296	4,195	1,930	.....	9,815
On hand, unexamined, July 1, 1872.....										1,716	821	2,537

At the date of this report the number of money-accounts pertaining to years prior to 1872 remaining in the files unexamined is 668. The number of such property-returns is 1,056.

Previous to the fiscal year the examination of property-returns was only partially made in this office, and completed by the accounting officers of the Treasury. Under General Orders No. 64, Adjutant General's Office, October 25, 1871, a complete examination of property-returns is now made in this office, and they are not forwarded to the Treasury Department until all necessary corrections have been made. Notwithstanding the increase of work resulting from this change, a very satisfactory gain has been made on the work in arrears.

During the year eighty settlements have been made of officers' accounts under the act of June 23, 1870. The amount allowed by such settlements is \$52,159.70.

The number of clerks employed in the accounts branch is fifty-six, classified as follows: One of class four, five of class three, six of class two, and forty-four of class one. So large a proportion in the lowest grades has the effect of causing some of the most efficient to seek and obtain promotion in other offices.

Believing that the efficiency of the branch would be greatly increased thereby, I respectfully recommend that the clerks in this branch be classified as follows: One clerk of class four, twelve clerks of class three, sixteen clerks of class two, and twenty-seven clerks of class one.

I am, very respectfully, your obedient servant,

J. D. BINGHAM,

Quartermaster, Brevet Brigadier-General, U. S. A.

The QUARTERMASTER-GENERAL OF THE ARMY.

3.—*Report of Major J. D. Bingham, quartermaster U. S. A.*QUARTERMASTER-GENERAL'S OFFICE,
Washington, D. C., September 30, 1872.

GENERAL: I have the honor to submit the following report of the clothing branch of this office for the fiscal year ended June 30, 1872.

The work of this branch has been as follows: The distribution of clothing and equipage required by the Army, to the various military posts throughout the country; replenishing the stock with articles not on hand, and required; the care and preservation of the large stock of clothing, equipage, and materials on hand at the two principal depots at Philadelphia and Jeffersonville.

The issues of clothing and equipage to the Army are exhibited in the accompanying statement, marked 1. The same statement shows the large quantities of clothing which have been sold during the fiscal year, principally on account of its unserviceable condition, either from damage by moths, long storage, or other defects discovered while being overhauled preparatory to repacking for issue or for storage. The amount realized from sales of this kind, which have generally been made at public auction after due advertisement, and from sales of clothing made to officers of the Army for their own use, was \$1,861,373.63, of which \$1,843,831.40 were deposited in the Treasury of the United States, as provided by law. Of this amount, \$1,291,830.16 were obtained at the sale at Jeffersonville, in September, 1871. Only \$1,266,830.16 of this amount have been turned into the Treasury, as \$25,000 worth of the clothing thus sold was, under authority of the Secretary of War, transferred by one of the purchasers to the National Asylum for Disabled Volunteers (General B. F. Butler, president) and the account presented to said institution for payment. The records of the office do not show that this amount has been placed on the books of the Treasury Department to the credit of the Quartermaster's Department. Five hundred and ten thousand four hundred and twenty-three dollars and seventeen cents were realized from sales made at the Schuylkill Arsenal, at Philadelphia, Pennsylvania. The original cost of the articles sold during the fiscal year was \$10,369,950.59.

The appropriations by Congress for clothing and equipage during the fiscal year, including \$50,000 appropriated for preservation of the stock on hand, were \$650,000, to which should be added \$17,542.23, received by various officers from sales, and again used in the purchase of articles of clothing and equipage. The expenses on account of clothing and equipage were \$667,529.63. Balance in Treasury, \$13.20. The amount turned into the Treasury from sales of clothing and equipage was \$1,843,831.40, an excess of \$1,176,302.37 over the amount used for clothing and equipping the Army during the same period.

Upon the recommendation of the Quartermaster-General, the Secretary of War authorized the transfer of the control and issue of knapsacks, haversacks, canteens, and great-coat straps from the Quartermaster's to the Ordnance Department; and all of those articles found to be in a serviceable condition have been turned over to that Department. The sum of \$20,800 was also transferred from the appropriation for clothing to that for ordnance, this being the amount appropriated by Congress for the purchase of such articles. Forty-one thousand nine hundred and fifty-three dollars will also be transferred from this year's appropriation for the same purpose.

In my last report, reference was made to the great losses sustained by the Quartermaster's Department from the destruction of woollen fabrics

by the ravages of moths and to the experiments then being made to protect the large supplies on hand by use of a process said to render woolen articles moth-proof. Congress having appropriated a sufficient amount to make the trial on a more extended scale, great and uniform coats, blouses, and materials were submitted to the process, and from reports of officers to whom such articles were issued, and also from the officers in charge of depots, it appears that the results of the trial have been very favorable, and it is expected that large losses will be avoided hereafter. Of the amount appropriated for this purpose by Congress at its last session, a portion is now being expended in the preparation of materials in store.

The brass-screwed bootees referred to in last year's report, of which a limited supply was procured and issued to troops for trial, having given such universal satisfaction, the Quartermaster-General submitted the subject to the Secretary of War, who, upon the recommendation of a board of officers, selected the brass-screwed boot and bootee as the standard for the Army. The old stock of boots and bootees in store since the war having deteriorated to such an extent as to render them unfit for issue to enlisted men, purchases of the brass-screwed are now made to fill all requisitions. These boots and bootees are considered much superior to any previously issued to the Army.

The large stock of woolen blankets on hand at the close of the war having become exhausted, efforts were made to contract for a year's supply that should be equal to those issued to the Army before the war. On examination it was ascertained that the blankets thus contracted for were not up to the standard intended by the Quartermaster-General. Some sample blankets were then obtained from California, one of which was adopted by the Secretary of War as the standard for future purchases of woolen blankets. A supply has recently been purchased by contract at San Francisco for issue to troops on the Pacific coast, and a contract is now being made at Philadelphia for supplying the depot at the Schnylkill arsenal, all in conformity with the new standard. Such instructions have been given relative to inspection during the process of manufacture as will, it is believed, secure the best blankets ever issued to the Army.

Samples of stockings have also been manufactured to order and adopted as standards, and it is expected that the quality of stockings will hereafter prove satisfactory to the Army.

A few complaints having been made that the tariff of sizes, according to which trousers and bootees are issued from the principal depots, caused an accumulation at military posts of sizes not required, instructions were given to furnish the particular sizes named in the requisitions, without reference to the tariff, and for the careful inspection of all articles required in filling each requisition before shipment, with a view of furnishing only the best on hand and to secure uniformity of color of woolen garments.

The expenses of the depots at Philadelphia and Jeffersonville, which had been about \$10,000 per month, have been reduced to about \$7,000 per month.

The President of the United States having approved some changes in the uniform of the Army, efforts are now being made to have the new uniform ready for distribution by the 1st of December next. The changes of course render a large quantity of clothing now on hand unserviceable and increase the expense of clothing the Army to some extent. A further appropriation by Congress at its coming session will be required for the present fiscal year, to meet the additional expense. The receipts from

sales of clothing and equipage during the fiscal year, which, under existing laws, are being covered into the Treasury, will, it is believed, amount to more than the appropriation required.

Seven claims on account of clothing and equipage, principally under the act of July 4, 1864, amounting to \$8,567.65, have been received during the fiscal year and have been acted upon.

The clerical force of this branch has remained the same during the fiscal year as on the 30th of June, 1871, viz, 18 clerks and 3 laborers.

Prior to the fiscal year returns of clothing and equipage were but partially examined in this office, the examination being completed at the Treasury Department. But under General Orders No. 7, Adjutant-General's Office, 1872, returns for the fiscal year have been thoroughly examined in this office and corrected before being sent to the Second Auditor for final settlement. Notwithstanding the increased work thrown upon the branch by such examination, the work has been kept up to date throughout the year.

For further details of the operations of the clothing branch, I respectfully refer to the accompanying statements, viz:

1. Statement showing, as far as can be ascertained from the records of this office, the quantity of clothing, camp and garrison equipage, and clothing materials in the hands of officers of the Army June 30, 1871; the quantity of clothing and equipage purchased, manufactured, sold, lost, and issued to the Army of the United States during the fiscal year ended June 30, 1872; and the quantity remaining on hand for the supply of the Army at that date.

2. Statement of amounts received from the sale of surplus serviceable, unserviceable, damaged and irregular articles of clothing, &c., sold at the principal clothing depots, &c.; also of the amounts derived from sales to officers, &c., during the fiscal year ended June 30, 1872.

3. Statement showing expenditures on account of clothing, camp and garrison equipage during the fiscal year ended June 30, 1872.

4. Statement of the amounts received and expended by the Quartermaster's Department on account of clothing and equipage during the fiscal year ended June 30, 1872.

5. Statement of returns of clothing, camp and garrison equipage received, examined, and transmitted to the Treasury Department, and of letters received and written during the fiscal year ended June 30, 1872.

Very respectfully, your obedient servant,

J. D. BINGHAM,
Quartermaster, United States Army.

THE QUARTERMASTER-GENERAL OF THE ARMY.

A.—Statement showing, as far as can be ascertained from the records of this office, the quantity of clothing, camp and garrison equipage, and clothing material in the hands of officers of the Army June 30, 1871, the quantity of clothing and equipage purchased, manufactured, sold, lost, and issued to the Army of the United States during the fiscal year ending June 30, 1872, and the quantity remaining on hand for the supply of the Army at that date.

Articles	On hand June 30, 1871.	Purchased during the fiscal year ending June 30, 1872.	Manufactured during the fiscal year ending June 30, 1872.	Taken up during the fiscal year ending June 30, 1872.	Total on hand June 30, 1872.	Issued to troops during the fiscal year ending June 30, 1872.	Sold during the fiscal year ending June 30, 1872.	Lost, expended, condemned, &c., during the fiscal year ending June 30, 1872.	Total issued, sold, lost, &c.	Total remaining on hand June 30, 1872.
Hats.....	296,016			32	296,048	15,831	2,216	510	18,537	277,491
Uniform-coats.....	2,104				2,138	36		14	558	1,550
Forage-coats.....	419,176	34		152	419,328	80,603	79,451	1,019	101,073	318,255
Cap-coverts.....	63,613	3,000			66,613	1	5,558	6,142	5,901	61,419
Cap-bugles.....	387,308			201	387,509		7,724	7,724	15,496	372,013
Cap-letters.....	1,111,619			1,257	1,112,876		40,158	11,159	51,317	1,061,559
Cap-tees.....	14,301				14,301		646	387	1,033	13,168
Cap-tees.....	19,738				19,738		10	37	19,691	13,168
Shells and flames.....	584,523			598	585,121	10,970	9,976	1,020	91,966	563,855
Cords and tassels.....	337,683			250	337,933	9,349	337	1,428	11,114	326,819
Ostrich-feathers.....	676,487			675	577,162		5,382	4,472	9,854	567,308
Regalia.....	1,871,106	83,500		937	1,855,543		26,222	10,787	37,309	1,558,234
Numbers.....	1,190,540			1,441	1,200,981		6,453	9,846	9,399	1,191,682
Crossed sabres.....	131,005			15	131,020		8,983	1,112	3,795	147,225
Trumpets.....	116				116					116
Trunks.....	2,664			1	2,665		128	37	165	2,500
Hair plumes.....	9,077				9,077	94	83	12	189	1,888
Cap-rings.....	4,585			3	4,588		334	89	432	4,165
Hospital stewards' hats, cords, and tassels.....	9,845				9,845					9,845
Letters U. S. hospital stewards'.....	243			18	261					261
Wreaths, hospital stewards'.....	250				250					246
Bands and tassels, (red).....	1,217			17	1,234	27	4	12	43	1,191
Cap-earrings.....	2,170				2,170		29	8	37	2,133
Cap-sockets.....	70,983				70,983			137	137	70,846
Cap-plates.....	327				327					327
Uniform coats.....	342,569		22	39	342,830	3,563	66,759	461	90,809	252,121
Metallic scales:										
Non-commissioned staff.....	5,331				5,348		78	48	126	5,223
Sergeants'.....	11,500			17	11,517		698	737	1,435	12,670
Corporals and privates'.....	403,258	2,540		65	405,863		7,236	6,442	13,165	389,950
Buttons for scales.....	9,534			370	9,904		92	73	9,369	9,369
Sashes.....	14,447				14,447		643	271	914	13,537
Uniform-jackets.....	462,339		16	9	462,364	3,063	69,154	540	72,756	305,608
Trowsers.....										
Foot.....	338,926		35,102	25	424,053	49,665	171,496	1,166	222,327	901,726

A.—Statement showing, as far as can be ascertained from the records of this office, the quantity of clothing, &c.—Continued.

Articles.	On hand June 30, 1871.	Purchased during the fiscal year 1872.	Manufactured during the fiscal year 1872.	Taken up during the fiscal year 1872.	Total on hand June 30, 1872.	Issued to troops during the fiscal year ending June 30, 1872.	Sold during the fiscal year ending June 30, 1872.	Lost, expended, condemned, &c., during the fiscal year ending June 30, 1872.	Total issued, sold, lost, &c.	Total remaining on hand June 30, 1872.
Trowsers—Continued.										
Mounted.....	150,703		19,327	102	170,042	26,290	54,207	453	82,950	87,092
Overalls.....	10,725			1	10,726	1,556		163	2,303	8,433
Flannel sack-coats:										
Lined.....	479,199		3,077	31	482,237	45,040	137,173	988	183,240	298,997
Unlined.....	416,447		34	1	416,482	8,559	62,586	445	71,990	344,492
Shirts:										
Flannel.....	688,310	3		96	688,339	72,706	239,793	6,116	318,615	369,724
Knit.....	5,217			1	5,218	1,690	2,410	118	5,218	5,218
Drawers.....	862,583	3	36	13	862,635	105,966	19,413	5,917	131,315	731,320
Boots.....	219,189	90,933		69	240,061	37,969	34,507	709	73,205	166,856
Boots.....	797,762	10,316		67	808,145	58,006	100,267	3,378	161,651	646,494
Leggins.....	8,598				8,598	58,006	9,664	14	3,384	5,314
Gaiters.....	3,821				3,821					3,821
Stockings.....	596,647				596,647					596,647
Leather-stocks:	156,418	87,060		54	693,761	141,910	330,473	5,569	477,952	215,809
Great-coats:				822	157,240	167	138,680	653	139,680	17,560
Mounted:										
Foot.....	173,175		*3,716	8	174,899	8,159	47,247	3,276	58,682	116,217
Foot.....	394,909		*3,300	15	398,134	10,327	137,954	3,207	141,288	256,796
Straps.....	811,907			183	812,090	9,315	13,286	598,857	591,458	220,632
Blankets:										
Woolen.....	205,468	42,021		23	247,512	25,975	88,738	117,151	131,864	115,648
Rubber.....	436,551			176	436,727	1,627	97,789	685	30,041	406,686
Ponchos:										
Rubber.....	337,979			417	338,396	2,291	65,911	980	68,595	989,831
Painted.....	2,551				2,551	28	18	585	2,591	1,970
Stable-frocks.....	40,586				40,586	7,997	1,921	210	8,428	39,701
Buffalo-overcoats.....	2,673	2,873	8,633		5,546	1,313	2,167	57	3,517	2,039
Buffalo-overcoats.....	2,408				2,408			1	3,407	1
Mittens wool.....	19,973	3,681		1	23,655	4,033	536	6	4,573	19,080
Mittens buck.....	720				720	34	3		37	683
Chevrons:										
Ordnance sergeant.....	409		620		1,029	8	19	1	28	1,001
Cavalry sergeant-major.....	1,371				1,371	7	19	2	28	1,343
Cavalry quartermaster sergeant.....	2,006			18	2,024	10	33		43	1,961
Cavalry company sergeant.....	33				33				5	28
Cavalry first sergeant.....	4,140			26	4,166		74	1	90	4,076
Cavalry sergeant.....	11,412			19	11,430	237	281		516	10,914

Cavalry corporal.....	24,929				75	25,004	108	449	698	24,366
Artillery sergeant-major.....	1,343					1,943		17	17	1,343
Artillery quartermaster sergeant.....	1,457					1,457		15	15	1,457
Artillery first sergeant.....	33					33				33
Artillery sergeant.....	3,377					3,377	2	67	69	3,308
Artillery corporal.....	14,031					14,034	12	45	57	13,917
Infantry sergeant-major.....	17,915				3	17,918	20	69	79	17,839
Infantry quartermaster sergeant.....	1,378				3	1,381	13	94	107	1,274
Infantry first sergeant.....	1,665				8	1,673	9	313	223	1,451
Infantry commissary sergeant.....	251					251		3	3	248
Infantry commissary sergeant.....	11,356				10	11,366	53	647	712	10,634
Infantry first sergeant.....	22,343				48	22,391	476	1,699	2,227	20,064
Infantry corporal.....	38,107				48	38,155	511	2,327	2,796	35,359
Hospital steward.....	799				1	799	2			797
Caduceus.....	72,390					72,390	64	599	663	71,797
Service.....	42,979				1	43,049	17	20	38	43,011
Miscellaneous.....	306,307					311,717				295,556
14-inch sergeants'.....	563,566				410	567,988		6,445	492	558,037
Miscellaneous.....	1,186,038				383	1,188,436		4,985	882	1,190,285
Bed-sacks:										
Single.....	104,477				256	116,526		11,326	8,484	98,718
Double.....	42,680				17	49,643		3,868	7,058	42,585
Mosquito-bars:										
Single.....	63,103				35	63,586		3,410	1,398	58,822
Double.....	2,988				3	6,451		200	213	6,238
Spades.....	85,955				6,400	92,355		792	4,437	87,918
Spade-aliases.....	1,500					1,500				1,500
Shovels.....	50,341				7,108	57,523		1,170	1,751	55,791
Knapsacks:										
Painted.....	453,587				554	455,988		328,646	111,469	15,873
Unpainted.....	973					973				973
Patent.....	693					703		948	365	90
Straps.....	14,720					14,720			10,817	3,903
Haversacks:										
Painted.....	311,639				453	344,213		156,425	105,599	22,188
Unpainted.....	8,192					8,192		5,301	5,305	2,887
Patent.....	546					546			80	466
Canteens:										
Complete.....	859,459				491	859,950		22,944	496,726	336,280
Corks.....	321,328					321,328			4,000	315,370
Straps.....	327,953				279	328,237		1,659	15,386	311,192
Patent.....	447					447			98	349
Arms.....	71,433					71,433		5,744	1,831	80,063
Ar-helms.....	46,779				26,104	73,435		9,449	7,328	63,658
Ar-aliases.....	30,819				7	30,826		33	5	30,798
Camp-kettles.....	101,357				76	101,433		9,796	3,580	95,057
Meese-pans.....	411,346				222	411,568		1,424	1,965	408,179
Hatchets.....	121,851				1,417	123,268		1,159	1,799	121,469

Seal skin.

12,999 used in lining great-coats.

* Blanket-lined.

Fifteen	13,800	13,811	942	149	391	13,420
Drums:						
Complete	4,905	4,911	92	153	950	4,661
Heads, better	11,017	11,066	317	1,436	1,747	9,310
Heads, same	15,580	15,556	469	1,664	1,667	13,889
Silings	11,453	11,454	381	1,164	1,565	10,880
Sticks, pairs	17,658	17,670	187	234	491	17,949
Stack-carriages	13,509	13,600	45	19	64	13,545
Cords	5,304	5,598	953	470	733	4,865
Carves, sets	10,879	10,884	363	249	619	10,282
Cases	6,963	6,981	210	50	960	6,061
Tents:						
Hospital	5,769	5,955	158	468	696	5,399
Hospital-dies	5,330	5,598	150	557	707	4,815
Hospital-poles, sets	7,170	7,357	459	978	737	6,690
Wall	7,165	7,187	1,059	618	1,677	7,505
Wall-dies	7,009	8,738	1,743	1,837	2,570	6,168
Wall-poles, sets	13,197	13,268	449	1,694	2,185	12,185
Common	94,531	31,836	8,823	9,794	5,617	26,219
Common poles, sets	29,386	30,968	2,149	1,439	3,581	27,407
Shelter	717,093	717,118	1,191	12,943	13,484	703,694
Shelter-poles, sets	103,487	103,767	26,599	7,012	26,775	77,012
Silley	89	89	36	7	45	37
Silley poles	453	455	81	106	167	968
Silley tripods	313	313	26	8	55	278
Miscellaneous	933	933	21	64	85	868
Extra wall ridge-poles	15	15		1		14
Shelter-tent guy's	1,170	1,170				1,170
Shelter-tent rings and cords	980	980				980
Rope feet	18,544	18,544				18,544
Tent-pins, assorted	1,667,873	1,668,570	23,767	69,503	86,590	1,610,989
Silley-tent pipes, joints	2,183	2,149	33	18	41	2,121
Silley-tent pipe, sets			30	193	193	335
Silley-tent poles	728	728		16	53	2,800
Iron Poles	53,896	61,104	37	153	801	60,363
Pickets	80,417	86,839	616	683	1,533	87,406
Picket-elves			940			
Boots:						
Clothing account, company	12,444	12,446		130	130	12,316
Descriptive, company	12,847	12,847		92	92	12,755
Order, company	12,844	12,845		198	198	12,647
Morning report, company	13,661	13,663		136	136	13,526
Post order	5,883	5,886		16	16	5,870
Post morning report	6,439	6,440		12	12	6,428
Post letter	6,147	6,151		19	19	6,132
Post guard report	3,024	3,028		64	64	3,062
Regimental general order	2,185	2,185		10	10	2,175
Regimental letter	2,006	2,009		13	13	1,996
Regimental descriptive	2,625	2,639		3	3	2,636
Regimental index	2,528	2,528		6	6	2,520
Regimental order	2,178	2,183		9	9	2,183
Target practice	2,469	2,469		5	5	2,464

QUARTERMASTER-GENERAL.

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Burlaps, yards.....	4,001	23,607	1,010	28,618	14,639	14,639	13,979
Sewing-cotton, pounds.....	90,253	36,500		350			350
W-troleum-paper, pounds.....	7,863	103		54,752	18,315	18,315	38,437
Wrapping-paper, reams.....	1,141	2,569		7,965	70	70	7,895
Baling-rope, pounds.....	1,500	1,950	931	3,661	1,622	1,622	2,039
Hickory-straps.....		1,950		2,746	1,790	1,790	2,000
Sewing-silk, spools.....		946		946	946	946	946
Sewing-silk, pounds.....					7-16	7-16	1-16
Walla, papers.....		10,000		10,000			10,000
Blue-lumber, feet.....		18,790		18,790	1,790	1,790	17,000
Blue-lumber, cotton.....		1,068		1,068	1,068	1,068	1,068
Blocking-twine.....		598		598	598	598	598
Black-bottons, number.....		90,000		90,000			90,000
Bed-sack tape, pieces.....		1,000		1,000			1,000
Bed-sack, tent poles.....		180		180			1,180
Silk tassel.....	1			1			1
Swan fountain-plumes.....	1			1			1
Culture plumes.....	1			1			1
Gilt aiguillette.....	10			10			10
Scarlet-cloth.....	185			185			185
Gilt epaulet.....	26			26			26
White duck, yards.....	50			50			50
White Holland.....	24			24			24
Light-blue flannel.....	257			257			257
Canvas, yards.....	139			139	60	60	89
Hemp-twine, pounds.....	8,409			8,409	505	505	7,904
Flax-twine, pounds.....	58,300			58,300	18,545	18,545	39,755
Cotton-twine, pounds.....	58,757			58,757	64	64	693
Clothing-tickets.....	7			7			7
Tailors crayons, boxes.....	13			13			13
Uniform-coats, white.....	1			1			1
Uniform-trousers, linen.....	5			5			5
Uniform-jackets, red.....	23,483			23,483			23,483
Black wadding.....	34			34			34
Fur caps.....	87,167			87,167			87,167
Snow-packs.....					15,964	15,964	71,902
Manilla-rope, quarter inch, pounds.....					143	143	1,856
Seal skins.....							1,698
Tent-cuttings.....							1,012
Great-coats, lined.....							
Scraps, pounds.....							
Regs, pounds.....							
Musical instruments, number.....							

Respectfully submitted.

J. D. BINGHAM,
Quartermaster, United States Army.

QUARTERMASTER-GENERAL'S OFFICE, September 30, 1872.

B.—Statement showing expenditures on account of clothing, camp and garrison equipage during the fiscal year ending June 30, 1872.

Department of the Lakes, Detroit, Michigan.....	\$250 00
Department of the East, New York.....	226 10
Depot at San Francisco.....	920 00
Depot at Louisville, Kentucky.....	53,006 71
Depot at San Antonio, Texas.....	100 00
Depot at New Orleans, Louisiana.....	1,859 50
Depot at Fort Leavenworth, Kansas.....	3,600 00
Depot at Omaha, Nebraska.....	120 00
Depot at St. Paul, Minnesota.....	2,395 56
Depot at Saint Louis, Missouri.....	7,207 77
Depot at Chicago, Illinois.....	1,892 00
Depot at Washington, District of Columbia.....	541 70
Depot at New York.....	14,967 62
Depot at Jeffersonville, Indiana.....	61,911 67
Depot at Philadelphia, Pennsylvania.....	497,652 05
Columbus arsenal.....	60 00
Ordnance Department.....	20,800 00
Treasury settlement.....	18 35
Total.....	667,529 03

Respectfully submitted.

J. D. BINGHAM,
Quartermaster, United States Army.

QUARTERMASTER-GENERAL'S OFFICE, September 30, 1872.

C.—Statement of amounts received from the sale of surplus serviceable, unserviceable, damaged, and irregular articles of clothing, camp and garrison equipage and materials sold at the principal clothing depots and other stations; also of the amounts derived from sales to officers of the Army, during the fiscal year ending June 30, 1872.

From sales at Jeffersonville, Indiana.....	\$1,266,830 16
From sales at Philadelphia, Pennsylvania.....	510,423 17
From sales at San Francisco, California.....	60 86
From sales at Fort Snelling, Minnesota.....	1,680 10
From sales at New Orleans, Louisiana.....	7,976 93
From sales at San Antonio, Texas.....	4,331 99
From sales at Fort Union, New Mexico.....	2,442 42
From sales at various other depots and posts.....	42,509 06
From sales to officers.....	25,118 94
Total.....	1,861,373 63

Respectfully submitted.

J. D. BINGHAM,
Quartermaster, United States Army.

QUARTERMASTER-GENERAL'S OFFICE, September 30, 1872.

D.—Statement of the amounts received and expended by the Quartermaster's Department on account of clothing and equipage during the fiscal year ending June 30, 1872.

Receipts:

	Amount.
Appropriations by Congress.....	\$650,000 00
Received from sales.....	1,861,373 63
Total receipts.....	2,511,373 63
Total expenditures.....	2,511,360 43
Balance in Treasury.....	13 20

Expenditures:

Expenditures for clothing and equipping the Army	\$646,710 68
Transfer to Ordnance Department on account of knapsacks	20,800 00
Covered into the Treasury from sales, &c.	1,843,831 40
Treasury settlement	18 35
Total	2,511,360 43

Respectfully submitted.

J. D. BINGHAM,
Quartermaster, United States Army.

QUARTERMASTER-GENERAL'S OFFICE, *September 30, 1872.*

E.—Statement of returns of clothing, camp and garrison equipage received, examined, and transferred to the Treasury Department, and of letters received and written, during the fiscal year ending June 30, 1872.

Number of returns of clothing and equipage on hand June 30, 1871	118
Number of returns of clothing and equipage received during the fiscal year ending June 30, 1872	4,420
Total	4,538
Number of returns of clothing and equipage examined and transmitted to the Treasury Department	4,458
Remaining on hand June 30, 1872	80

Number of letters received during the fiscal year ending June 30, 1872	4,111
Number of letters written during the same period	11,189

Respectfully submitted.

J. D. BINGHAM,
Quartermaster, United States Army.

QUARTERMASTER-GENERAL'S OFFICE, *September 30, 1872.*4.—*Report of Major J. D. Bingham, quartermaster U. S. A.*

QUARTERMASTER-GENERAL'S OFFICE,
Cemeterial Branch, Washington, D. C., September 18, 1872.

GENERAL: I have the honor to submit the following report of the operations of the cemeterial branch of this office during the fiscal year ending June 30, 1872:

The number of interments in the national cemeteries reported last year, 317,850; the number of bodies of Union soldiers since found and removed to the cemeteries, 116; number removed by friends, 4; remaining in the cemeteries, 317,962; the number of known, 170,162; unknown, 147,800.

The appropriation for national military cemeteries for the fiscal year was \$200,000. To this was added in May, 1872, a deficiency appropriation of \$50,000, making the whole appropriation for the fiscal year \$250,000.

The following work has been done during the year:

Stone walls have been or are now being erected around the following cemeteries, viz: Annapolis, Maryland; Nashville and Stone River, Tennessee; Marietta, Georgia; City Point, Virginia; Jefferson City and Springfield, Missouri; Salisbury, North Carolina; and Beverly, New Jersey.

Brick walls have been erected around the following cemeteries, viz: Corinth and Natchez, Mississippi, and Camp Butler, Illinois.

Superintendents' lodges have been or are now being erected at the national cemeteries at Culpeper and Hampton, Virginia; New Berne and Wilmington, North Carolina; Nashville and Stone River, Tennessee; Corinth, Mississippi; and Jefferson City, Missouri.

Coping has been contracted for the walls around the national cemeteries at Arlington, Alexandria, Ball's Bluff, and Richmond, Virginia; Soldiers' Home and Battle Ground, District Columbia; Jefferson Barracks, Missouri; Nashville and Stone River, Tennessee; Marietta, Georgia; and Wilmington, North Carolina.

The expenditures have been as follows:

For gates for inclosing walls	\$8,566 40
For walls, 33,057 linear feet	98,427 61
For lodges for superintendents, eight	35,410 70
For trees and shrubs	636 20
For labor	30,360 44
For repairs	23,361 25
For coping walls, 41,853 linear feet	46,779 29
Miscellaneous	6,458 11
Total	250,000 00

At the following national cemeteries permanent lodges for superintendents are required, viz: Andersonville, Georgia; Brownsville, Texas; Camp Nelson, Kentucky; Fayetteville, Arkansas; Beaufort, South Carolina; Fort Gibson, Indian Territory; Fort Leavenworth and Fort Scott, Kansas; Grafton, West Virginia; Knoxville and Pittsburgh Landing, Tennessee; eleven lodges in all.

The following national cemeteries require permanent inclosures, to wit: Andersonville, Georgia; Culpeper, Fort Harrison, and Fredericksburg, Virginia; Fayetteville and Fort Smith, Arkansas; Fort Gibson, Indian Territory; Fort Leavenworth and Fort Scott, Kansas; Lexington, Kentucky; Mound City, Illinois; Whitehall, (Bristol,) Pennsylvania; Grafton, West Virginia; Memphis, Tennessee; and Chalmette, (New Orleans,) Louisiana.

The amount required for the erection of these lodges and inclosures is estimated approximately at \$238,240, namely:

Eleven lodges, at \$4,000	\$44,000
Walls at—	
Andersonville, Georgia, 6,756 feet, at \$5	33,780
Culpeper, Virginia, 2,077 feet, at \$5	10,385
Fort Harrison, Virginia, 910 feet, at \$5	4,550
Fredericksburgh, Virginia, 2,831 feet, at \$5	14,155
Fayetteville, Arkansas, 1,864 feet, at \$5	9,320
Fort Smith, Arkansas, 1,865 feet, at \$5	9,325
Fort Gibson, Indian Territory, 1,800 feet, at \$5	9,000
Fort Leavenworth, Kansas, 1,900 feet, at \$5	9,500
Fort Scott, Kansas, 1,848 feet, at \$5	9,240
Lexington, Kentucky, 1,920 feet, at \$5	9,600
Mound City, Illinois, 2,760 feet, at \$5	13,800
Whitehall, Pennsylvania, 848 feet, at \$5	4,240
Grafton, West Virginia, 1,373 feet, at \$5	6,865
Memphis, Tennessee, 5,462 feet, at \$5	27,310
Chalmette, Louisiana, 4,634 feet, at \$5	23,170
Total	238,240

The national cemetery at Chalmette, (New Orleans,) Louisiana, is inclosed on two sides, 500 feet, with iron railings; the other two sides, each 2,317 feet long, have only a wooden picket fence.

The national cemetery at Vicksburgh, Mississippi, with a circumference of about 5,576 feet, is situated on the bank of the Mississippi river. One side of the cemetery borders on a ravine where it would be impossible to build a wall or even a fence. An Osage orange or pyracantha hedge would be the most suitable inclosure. Only about 1,700 feet can be inclosed by a wall, which, at the rate of \$5 per foot, would amount to \$8,500; and the total amount for walls would then be \$202,740, and the total amount required \$246,740.

The land occupied by the Gettysburgh national cemetery was purchased by the State of Pennsylvania, and the title vested in the State in fee-simple in trust for all the States having soldiers buried therein. On the 14th of April, 1868, the general assembly of Pennsylvania passed an act authorizing the commissioners in charge of the cemetery to transfer to the United States all the right, title, interest, and care of the same upon its completion, the cession being made upon condition that the United States Government take upon itself the management and care of the cemetery and make provisions for its maintenance.

By resolution of Congress approved July 14, 1870, the Secretary of War was directed to accept and take charge of the cemetery whenever the commissioners in charge of it were ready to transfer its care to the General Government.

On the 22d of June, 1871, the commissioners passed a resolution authorizing Daniel Wills, esq., the president of the board, to transfer the cemetery to the officer authorized to receive the same on the part of the United States.

On the 28th of February, 1872, Mr. Wills notified the Quartermaster-General that he was ready to make the transfer, and on the 11th of April, by your order, I visited and inspected the cemetery. Mr. Wills completed the transfer on the 18th of April by forwarding the deed to this office.

No report has been received from the Antietam Cemetery Association relative to the proposed transfer of that cemetery to the United States.

A contract has been made for the erection, at the Nashville military cemetery, of an arched gateway of the same design as the one at Arlington.

By the act approved June 8th, 1872, Congress directed the Secretary of War to cause each grave in the national military cemeteries to be marked with a small head-stone, with the name of the soldier and the name of his State thereon, if known, and also the number of the grave; and to advertise within ninety days from the passage of the act for proposals for furnishing the head-stones and placing them in position at the head of the graves. No action on this was taken before the close of the fiscal year.

By act of Congress, approved May 18, 1872, the compensation of superintendents of national cemeteries was fixed at from \$60 to \$75 per month, according to the extent and importance of the cemeteries to which they are assigned, and fuel and quarters as previously allowed.

The Adjutant-General has decided that under this act superintendents are not entitled to medicines or medical attendance at the expense of the Government.

By act of June 1, 1872, all soldiers and sailors, honorably discharged from the service of the United States, who may die in a destitute condition, are allowed burial in the national cemeteries.

On the 20th of June, 1872, the Secretary of War directed that the whole of the cemeterial business be placed under the charge of an officer of the Quartermaster's Department, to be on duty in this office,

who shall, under your direction, conduct all the correspondence and business pertaining to the cemeteries, directly with the superintendents or the officer in charge, to have charge of all funds appropriated for national cemeteries, and not to be assigned to any other duty that will interfere with the proper discharge of his cemeterial duties. Also, authorizing the detail of an officer, if necessary, for this special duty.

Twenty-six volumes of the Roll of Honor have already been published. Volumes 27 and 28, (the latter a revision of volumes 1 and 4, and containing a record of 21,192 graves,) are in the hands of the Public Printer, and volume 29 is in course of preparation.

Superintendents are required at sixty-two cemeteries. Ten were appointed during the year; four resigned; two died; two were dismissed, and fifty-nine remained on duty at the close of the year.

I am, general, very respectfully, your obedient servant,

J. D. BINGHAM,

Quartermaster, United States Army.

The QUARTERMASTER-GENERAL OF THE ARMY.

5.—Report of Major M. I. Ludington, quartermaster U. S. A.

QUARTERMASTER-GENERAL'S OFFICE,

September 21, 1872.

GENERAL: I have the honor to report that during the past fiscal year I performed duty in your office in charge of the several branches thereof pertaining to the collection of the debts due the United States from southern railroad companies; the transportation of the Army, barracks and quarters, regular and miscellaneous supplies, and the examination of miscellaneous claims, and claims filed under the act of July 4, 1864.

The following report of the general operations of these branches of your office during the fiscal year ending June 30, 1872, is respectfully submitted:

INDEBTED RAILROAD COMPANIES.

At the close of the fiscal year ending June 30, 1871, there was due the United States from railroad companies which purchased railway material and rolling-stock, under the provisions of executive orders of August 8 and October 14, 1865, and repairs to railroads, \$4,724,350.53. During the fiscal year ending June 30, 1872, interest has accrued upon this indebtedness and expenses have been incurred to the amount of \$148,224.65. Payments have been made and credited the companies to the amount of \$138,132.75, leaving unpaid on the 1st of July, 1872, \$4,734,442.43—\$10,091.90 more than on the 1st of July, 1871.

Two companies, the Memphis and Ohio, and the Washington, Alexandria and Georgetown, discharged their indebtedness, during the year, paying to the United States the sum of \$12,415.57.

Eight companies, the Alexandria, Loudoun and Hampshire, the East Tennessee and Virginia, the Knoxville and Kentucky, the Mississippi and Tennessee, the Nashville and Chattanooga, the New Orleans and Ohio, the Pacific Railroad of Missouri, and the Selma, Rome and Dalton, reduced their indebtedness \$61,787.44. These companies also paid on

account of interest \$23,104.35, making their total payments during the year \$84,891.71.

The indebtedness of ten companies, the Alabama and Chattanooga, the East Tennessee and Georgia, the Edgefield and Kentucky, the McMinnville and Manchester, the Mississippi, Gainesville, and Tuscaloosa, the Mobile and Ohio, the Memphis, Clarksville and Louisville, the Memphis and Little Rock, the Nashville and Northwestern, and the Nashville and Decatur—has increased \$84,294.91. They have, however, paid to the United States during the year, \$40,825.39.

The indebtedness of the Indianola Railroad Company remains as at the commencement of the year.

In addition to the amount stated above to have been received and applied to the liquidation of this indebtedness, accounts for transportation of troops and supplies have been filed and are under examination as follows, to wit:

Alabama and Florida Railroad Company, in Treasury Department.....	\$11,573 82
Mobile and Ohio Railroad Company, in Treasury Department.....	70,362 87
Mobile and Ohio Railroad Company, in Quartermaster-General's Office...	5,905 05
Memphis and Little Rock Railroad Company, in Treasury Department...	2,165 88
Memphis, Clarksville and Louisville Railroad Company, in Treasury Department.....	3,445 77
Mississippi and Tennessee Railroad Company, in Treasury Department....	2,152 77
Nashville and Northeastern Railroad Company, in Treasury Department.....	1,424 70
Nashville and Chattanooga Railroad Company, in Treasury Department..	32,971 55
Nashville and Decatur Railroad Company, in Treasury Department.....	8,710 08
Pacific Railroad of Missouri in Treasury Department.....	841 00
Selma, Rome and Dalton Railroad Company, in Treasury Department....	1,880 80
Selma, Rome and Dalton Railroad Company, in Quartermaster-General's Office.....	4,937 58
Alabama and Chattanooga Railroad Company, in Quartermaster-General's Office.....	480 00
East Tennessee and Georgia Railroad Company, in Quartermaster-General's Office.....	687 10
East Tennessee and Georgia Railroad Company, in Treasury Department.....	7,890 73
East Tennessee and Virginia Railroad Company, in Treasury Department.....	16,595 10
East Tennessee, Virginia and Georgia Railroad Company, in Quartermaster-General's Office.....	663 92
Total.....	172,738 72

When these accounts shall have been finally examined and adjusted, they will be placed to the credit of the respective railroad companies, thereby reducing the total indebtedness, as shown above, to \$4,561.703.65.

There is also the sum of about \$60,000 due for postal service, which will still further reduce the debt.

Under the provisions of the act of March 3, 1871, (16 Statutes, ch. 109, p. 473,) empowering the Secretary of War to act in such cases, the suits against the East Tennessee and Virginia, and the East Tennessee and Georgia Railroad Companies, (now consolidated and known as the East Tennessee, Virginia and Georgia Railroad Company,) have been compromised for the sum of \$195,000; five thousand dollars cash, and one-half of the balance to be paid in ten, and the other half in fifteen years from January 1, 1872, with interest at the rate of four per cent. per annum, payable annually on the 1st day of January of each year, to be evidenced by two bonds of said company to the United States for said sums, with interest-coupons annexed, payment thereof secured by a mortgage upon all the property, rights, and income, and by the lien of

a decree to be entered in said cases, to be enforced by execution and sale in case of default.

The suit against the Nashville and Decatur Railroad Companies is under consideration by the War Department, and in a fair way of being satisfactorily compromised.

The suits against the Nashville and Northwestern, the McMinnville and Manchester, and the Knoxville and Kentucky Railroad Companies remain as at the beginning of the year.

A little more than a year ago proceedings in bankruptcy were commenced against the Alabama and Chattanooga Railroad Company in the district court of the United States for the middle district of Alabama. On the 13th day of March last, an order was made by said court directing the sale of the road and franchise of the company. The road was sold on the 22d of April, 1872, to the State of Alabama, for \$312,000. The claim of the United States was filed with the register in bankruptcy.

The sale of the road has been affirmed by the district court, and the claim of the United States declared to be a superior lien to all other liens and claims, except costs of suit. The district attorney writes that the governor of the State recognizes the justness and validity of the claim; also, that the United States will certainly get the money this fall.

The suit against the New Orleans and Ohio Railroad Company, which at the date of the last annual report was pending in the Supreme Court of the United States, was decided at the last term of said court in favor of the United States, and on the 11th day of April last the sum of \$10,946.47, being the value of the property on which the United States retained a lien, was paid to me and deposited to the credit of the Treasurer of the United States. There is still a balance due the United States of \$25,529.17; but as the company is bankrupt, the road having been sold under the first and second mortgages, there is no possibility of recovering the amount. All legal means to that end have been exhausted.

The Mobile and Ohio Railroad Company has filed transportation accounts, which, with its unpaid postal dues, are sufficient to nearly, if not quite, liquidate its indebtedness. These accounts, in connection with its accounts for purchases of property from the United States, are under examination and consideration by the accounting officers of the Treasury.

The claim against the Alabama and Florida Railroad Company, being for repairs to the road by the United States in 1865, is disputed by the company. An appeal having been taken from the ruling of the Quartermaster-General, approved by the Secretary of War, to the accounting officers of the Treasury, those officers have decided the case adverse to the United States, and made an award in favor of the railroad company. That award, together with all the papers and facts in the case, is now under consideration by the War Department.

The Mississippi, Gainesville and Tuscaloosa Railroad having been sold under its first mortgage to the Mobile and Ohio Railroad Company, there is no possibility that the amount due the United States will ever be collected. There is a small sum due for postal service over the road, which, by the provisions of the bond executed by said Mississippi, Gainesville and Tuscaloosa Railroad Company to the United States, should be applied to the liquidation of the debt, but such application of the postal earnings is resisted by the Mobile and Ohio Railroad Company.

Prior to the sale of the road, such of the property sold to the company

as had not been worn out and consumed, was restored to the United States and sold at public auction, and the sum of \$2,299 received and deposited to the credit of the Treasurer of the United States. There is still a balance due of \$40,069.72.

During the fiscal year, I received from indebted railroad companies, in money and postal dues, \$118,294.47, all of which has been deposited in the Treasury of the United States, and also credited upon their indebtedness.

TRANSPORTATION.

The number of persons transported by the Quartermaster's Department during the fiscal year was 54,063; the number of animals, 4,255; and the number of pounds of stores, 123,083,701. The amount expended for persons was \$488,168.10, and for freight, \$1,596,760.94. Total expenditures, \$2,084,929.04. This amount was paid by officers of the Quartermaster's Department. In addition thereto, claims and accounts to the amount of \$1,275,170.13 have been referred by this office for settlement during the fiscal year.

Since the adoption, several years since, of the general system now in force of providing transportation for the military service, and settling the accounts for the same, orders have been issued from time to time changing or modifying it in so many particulars, that officers of this Department are sometimes embarrassed in their action on account of the complication of instructions on the subject of transportation. These changes or modifications in the system have been found advisable by the practical experience of the Department, or were rendered necessary to comply with the laws of the country and regulations promulgated by proper authority for the government of the Army. Again, it has been found by the experience of the Department, that the system now in force necessitates, in certain details, considerable clerical labor, which might be saved by the adoption of a method simpler in its workings and requirements, and at the same time fully protecting the interests of the United States. For these reasons I have deemed it advisable that the present system should be remodeled, so as to save clerical labor, and to meet the requirements of the service at the present time; the system adopted to be published in general orders from the War Department. Accordingly letters were addressed to officers of the Quartermaster's Department inviting suggestions on the subject. After having fully considered the suggestions made by them, a draught of a proposed system was prepared and submitted to the Quartermaster-General for his approval or otherwise. Having received his approval, with such changes as he desired to make, it was, on July 30, by his direction, submitted to the Second Comptroller, under the requirements of the act of 3d of March, 1817, and is still with that officer.

LAND-TRANSPORTATION.

Under this head is classed, at this office, the transportation service performed by railroad, express, and stage companies, under contract or as common carriers, and by Government wagons and teams, as also by hired wagons and teams, employed under contract or otherwise.

RAILROAD-TRANSPORTATION.

The extent of the transportation service by railroad on account of the Quartermaster's Department, in connection with the movements of

the Army, and for its supply, and the cost of the service, are shown by the following statement compiled from the reports of officers, so far as rendered to this office:

Number of persons transported by railroad.....	24,567
Number of animals transported by railroad.....	3,636
Number of pounds of freight transported by railroad.....	52,850,235

The amount paid at posts, depots, and stations by disbursing officers of this Department, for this class of service, so far as has been reported, was \$411,599.08. In addition to this amount, there were examined in this office and referred for settlement at the Treasury, railroad accounts and claims amounting to \$1,157,764.72, making a total sum of \$1,569,363.80 paid by officers and referred for settlement through the Treasury, of which amount the sum of about \$1,300,000 was on account of service for the fiscal year.

Of the total sum the following amounts were allowed on the accounts of Pacific Railroads, settled through this office at the Treasury, viz:

	No. of accounts.	Amount.
To the Union Pacific Railroad Company.....	147	\$399,193 72
To the Kansas Pacific Railroad Company.....	29	166,113 20
To the Central Pacific Railroad Company.....	94	229,111 75
To the Western Pacific Railroad Company.....	8	64 50
To the Sioux City and Pacific Railroad Company.....	40	6,373 83
Total.....	318	800,857 00

Of the transportation service performed for this Department, as above stated, the number of persons and pounds of freight transported by these Pacific Railroads during the fiscal year were as follows:

	No. of persons.	Pounds, freight.
Union Pacific.....	3,645	14,501,918
Central Pacific of California, including Western Pacific.....	1,493	5,111,930
Kansas Pacific.....	3,939	16,858,340
Sioux City and Pacific.....	243	1,155,306
Total.....	9,320	37,627,544

The number and stated value of the Pacific Railroad accounts, received at this office during the fiscal year, were as follows:

	No. of accounts.	Amount.
Union Pacific Railroad Company.....	157	\$410,192 51
Kansas Pacific Railroad Company.....	29	171,450 12
Central Pacific Railroad Company.....	114	146,778 23
Sioux City and Pacific Railroad Company.....	35	13,581 10
Total.....	335	742,001 96

The table of land-grant railroads referred to in my last annual report has been completed, and was published in circular from this office of February 29, 1872.

WAGON AND STAGE TRANSPORTATION.

The business by wagon-transportation, during the fiscal year, has been as follows:

Number of persons transported.....	1,164
Number of pounds of freight transported.....	27,681,893

The amount paid for such transportation, during the fiscal year, by officers of this Department, so far as reported to this office, was \$1,050,780.76. In addition to this amount there were examined in this office, and referred to the Treasury for settlement, wagon-transportation accounts amounting to the sum of \$77,021.12, making a total amount paid for wagon-transportation of \$1,127,801.88, of which about \$1,100,000 was for services for the fiscal year. This service is usually performed under contracts, made yearly by the chief quartermasters of the military departments, at specific rates per 100 pounds per 100 miles, or per 100 pounds for the whole distance from the depot of supply to the point to be supplied.

During the year 1,227 persons and 459 pounds of freight were transported by stage. During the same time \$46,434.69 was paid on such account by officers of this Department, and accounts amounting to \$2,541.15 were referred by this office to the Treasury for settlement, making a total sum of \$48,975.84 paid on account of stage-transportation during the fiscal year.

During the year there was paid for miscellaneous services pertaining to land-transportation, such as for the services of the United States military railroad and telegraph employés, &c.; the sum of \$2,383.45.

WATER-TRANSPORTATION.

Four schooners, one sloop, one sail-boat, two flat-boats, eleven steamers, one propeller, and one barge have been in service as transports under charter during the year.

One steam-launch, one flat-boat, one barge, one propeller, and two schooners, owned by the United States, have been employed in transporting freight and passengers between points where no regular transports plied.

There were transported by water, during the fiscal year, 27,110 persons, 375 animals, and 4,255,114 pounds of freight.

The amount expended for water-transportation was as follows:

Paid by officers to common carriers.....	\$542, 100 49
Paid by officers for chartered vessels.....	34, 014 02
Paid through this office by accounting officers to common carriers.....	8, 000 00
Expense of running and maintaining Government vessels, including purchase of one steam-launch.....	42, 259 01
Total.....	626, 373 52

A steam-launch, built by Pusey, Jones & Co., of Wilmington, Delaware, under instructions of the Quartermaster-General, has been purchased by the Quartermaster's Department, at a cost of \$7,000, to run between Fort Pulaski and Savannah, Georgia, and was dispatched to its destination, Fort Pulaski, on the 22d of February, 1872, reaching there April 11.

This launch is 50 feet long, 12 feet in breadth, and 4 feet in depth, with an engine of 10-inch cylinder, and is covered by an awning fore and aft, with side curtains to protect the passengers in stormy weather.

During the trip of the launch from Wilmington, Delaware, to Fort Pulaski, severe gales were encountered, in which the anchor was lost and the steering-cable broken, but with these exceptions the vessel arrived in good condition at Fort Pulaski.

The expense of running and maintaining the launch is about \$137 per month; the average consumption of coal per round trip, 1,200 pounds;

speed, with the tide, 11.47 miles per hour; against the tide, 6 miles; average speed, 7.88 miles per hour.

The most important water-transportation service performed for this Department during the fiscal year, has been in the Military Division of the Pacific. The sum of \$361,088.89 has been paid by officers on such account.

Next in importance has been the service in the Military Division of the Missouri, costing the sum of \$156,810.25, about three-fourths of which were paid for transportation, under contract, of troops and supplies on the Missouri River, from Sioux City, Iowa, to the posts and stations above, on said river. At each letting of the contract for the transportation service on the Missouri River, for several years past, there has been some embarrassment in awarding the contract, on account of straw-bids and bids from irresponsible persons having been offered; but the Department has succeeded in securing the service at rates deemed to be reasonable.

In the Military Division of the Atlantic the sum of \$58,215.37 has been paid for transportation service by water.

BARRACKS AND QUARTERS.

NEW BUILDINGS.

During the fiscal year, ninety-five new buildings—barracks, officers' quarters, stables, store-houses, guard-houses, &c.—have been authorized at military posts in Maine, New York, Maryland, Virginia, North Carolina, South Carolina, Louisiana, Texas, Tennessee, Kentucky, Illinois, Kansas, Nebraska, and California, and in the Territories of Colorado, Dakota, Montana, New Mexico, Utah, Arizona, and the Indian Territory, at a cost of \$240,553.

WHARVES.

The sum of \$14,903 has been allowed for construction and repair of wharves.

HOSPITALS.

So far as reported, the sum of \$37,521 has been devoted to the construction and repair of hospitals.

REPAIRS.

As the public buildings at nearly all of the military posts are of a temporary character, many repairs are necessary every year to preserve and place them in a proper condition. For this purpose, and for the construction and repair of cisterns, wells, &c., the sum of \$92,948 has been expended upon estimates specially authorized.

The expenditures authorized for construction and repair in the several Departments have been as follows:

Department of the Missouri.....	\$58,119
Department of the Platte.....	10,350
Department of Dakota.....	111,450
Department of the East.....	78,898
Department of the Lakes.....	200
Department of the South.....	29,486
Department of Texas.....	68,060
Department of the Gulf.....	19,162

Department of California.....	\$5,200
Department of Arizona.....	3,000
Department of the Columbia.....	2,000
Total	<u>385,925</u>

NEW POSTS.

The War Department, by letter dated February 13, 1872, authorized the commander of the Military Division of Missouri to establish a four or five company post at or near Beaver City, Utah. The estimated cost of buildings is \$120,000; and application was made May 6, 1872, to Congress, for "early appropriation" of this sum, but no definite action seems to have been taken by Congress in the premises.

The War Department also, by letter of April 6, 1872, to the department commander, authorized construction of a two-company post at or near the point where the Northern Pacific Railroad crosses the Missouri River, the expense attending this work to be met by erecting only the requisite buildings for six companies at Fort Buford, Dakota Territory, instead of ten companies, as previously authorized, and the setting aside, from the moneys in the hands of the department quartermaster, such sum as would be a proper ratio of the whole amount transferred to him originally.

BUILDINGS SOLD.

During the fiscal year the sale at public auction of fifty-three buildings, of various dimensions, has been authorized by the Secretary of War.

PROPERTY TRANSFERRED.

By the act approved May 21, 1872, the Secretary of War and the Secretary of the Navy were directed to relinquish possession of the wharf and landing occupied by the United States in the city of New Orleans, Louisiana, and to turn over the same to the authorities of that city.

This valuable property was very useful to the Quartermaster's Department, but title of the United States thereto was simply that of right by capture.

DEPOT BUILDINGS AT JEFFERSONVILLE, INDIANA.

Work on the new fire-proof buildings at Jeffersonville, Indiana, authorized by act of Congress approved March 2, 1867, was commenced in the spring of 1871, and has been prosecuted with energy and economy. It is thought that the sum (of \$150,000) appropriated by Congress will fully complete the work. From last reports received, certain parts of the buildings have been completed and are now in occupation. When entirely finished the buildings will be an ornament to the city, and a safe repository for the stores of great value concentrated there.

The plan of this depot was designed by the Quartermaster-General of the Army, and all the drawings necessary for guidance in the work of building were prepared at this office under his direction.

The style of the architecture is Tuscan, well maintained throughout. The buildings are of brick and one story high. The fronts are constructed with arcades and pilasters of molded brick work. The arches of the exterior fronts are closed by blank brick walls, so as to leave no

openings, except the doorways in the middle of each exterior front. The arches looking to the court are closed by hinged wooden doors which give access and light to every store-room.

The building consists of numerous store-rooms, offices, &c., but all connected so as to form but a single structure, built in the shape of a square with an interior court or yard. Fire-walls without opening are laid up through the roof, thus dividing the building into separate ware-rooms for storage of property. The exterior dimensions of the square is 801 feet 4 inches, and the uniform width of the building is 52 feet 2 inches. The interior court or yard is 696 feet square. The four sides of the structure front upon four streets, and the depot covers an area of four squares of the city.

It is confidently expected that the work of building will be entirely completed during the month of October, proximo.

DEPOT AT SAN ANTONIO, TEXAS.

In my last annual report it was stated that the deeds executed by the city of San Antonio, conveying to the United States a site for depot buildings at that place, had been decided valid, and that by authority of the Secretary of War instructions had been given March 31, 1871, to commence the construction of the buildings, but it appears it was afterward found that through an error or misunderstanding of those having the matter in charge in Texas, the site conveyed was not that desired or expected. This prevented the commencement of the work, but on representation of the facts to the city authorities they very promptly conveyed additional ground to the United States. The title of the United States to the additional ground conveyed has been decided by the Department of Justice to be good and sufficient.

To carry out the work as contemplated funds had been set aside; but the deficiency bill, approved May 18, 1872, contains the proviso, "that hereafter barracks and quarters, and all buildings and structures whatever of a permanent nature, shall be constructed upon special authority to be given by act of Congress, except when constructed by troops, and no such structure, whose cost shall exceed \$20,000, shall be erected, or continued in erection, unless by such authority so specially granted."

As these buildings were to be of a permanent character, and no such "special authority" has been granted, the War Department has decided that "no further action about building can be had for the present." The department commander has therefore been requested to cause the \$100,000 to be turned into the Treasury to the credit of the appropriation for barracks and quarters.

PLANS, DRAWINGS, ETC.

During the past fiscal year the several draughtsmen employed in your office have been engaged in the preparation and revision of plans and estimates for proposed new buildings; in making plats of national cemeteries, and copies of maps of military reservations; in making for the files of this office tracings of all plans and drawings of structures authorized during the year to be erected, and in collecting and properly marking and filing the old plans, drawings, and maps on hand at this office, and systematizing the record of the same. The importance of having at this office a full description, with copies of the plans of construction, of all buildings throughout the country in charge of the Quartermaster's Department is apparent, and to such end a thorough

examination of the records has been made, and the proper officers called upon to prepare and forward any plans not on file and needed to complete the record. Although many of the plans are unskillfully drawn, yet it is believed that there are now at this office the necessary plans and drawings, or descriptions, to give an intelligent idea of the dimensions, character, and capacity of nearly all the public buildings, &c., constructed by the Quartermaster's Department, and now occupied or held at the various posts and stations throughout the United States.

IRON-FRAME BUNKS.

This branch of the office has until within a few months acted upon all business connected with the supply of iron barrack-bunks, but as it has been decided that bunks should more properly be classed with "camp and garrison equipage," all papers on file and correspondence relative thereto have been transferred to that branch of this office.

POST CEMETERIES.

Authority has been granted by the Secretary of War and instructions given by this office for the construction of a wooden fence around the Fort Brady, Michigan, Post Cemetery, and stone walls around those at Fort Kearney, Nebraska, Old Fort Lyon, Colorado Territory, and Fort Sedgwick, Colorado Territory, when proper title to the ground is vested in the United States.

Three interments have been reported during the fiscal year.

Instructions have been issued for the removal of four bodies from the cemetery at Fort Wadsworth, New York Harbor, to Cypress Hill Cemetery.

The Secretary of War, under date of June 19, 1872, directed that the graves (about 180) at Forts Hamilton and Wood, New York Harbor, should not be disturbed, but that no more interments should be made in the cemeteries at these two posts. When soldiers die there, their remains will be interred in the Cypress Hill Cemetery.

REGULAR SUPPLIES.

The following statement shows the number of animals, with their total and average cost, purchased in the several military departments during the fiscal year ending June 30, 1872:

Where purchased.	Cavalry horses.	Mules.	Total cost.	Average.
Department of the East	2	.....	\$300 00	\$150 00
Department of the East .....	.....	2	300 00	150 00
Department of the South	389	.....	55,918 76	143 73
Department of Texas	707	.....	72,736 14	102 92
Department of Texas .....	.....	180	25,962 50	144 23
Department of the Missouri	1,429	.....	176,062 64	123 21
Department of the Platte	98	.....	13,238 00	135 08
Department of Dakota*	No	reports rendered.	.....	.....
Department of California	158	.....	29,895 18	189 21
Department of California .....	.....	22	3,800 00	172 75
Department of Arizona	362	.....	44,816 90	123 80
Department of the Columbia	78	.....	12,480 00	160 00
Depot of Washington	15	.....	3,890 57	199 37
Depot of Washington .....	.....	5	1,207 50	241 50
Depot of New York	4	.....	600 00	150 00
Depot of Jeffersonville	2	.....	290 00	145 00
West Point, New York	33	.....	4,943 08	149 76
Total	3,277	209	445,568 27	.....

* The appropriation for the purchase of horses during the fiscal year was \$450,000, all of which was expended. No returns having been received from the Department of Dakota the entire expenditure is not shown by this statement.

The following is a tabular statement of the sales of public animals in the different departments, showing number sold and amount realized:

Departments.	Horses.		Mules.		Oxen.		Total.	
	No.	Amount.	No.	Amount.	No.	Amount.	No.	Amount.
Department of the East.....	22	\$692 64	3	\$334 00			25	\$1,326 64
Department of the Lakes.....	4	178 00					4	178 00
Department of the South.....	43	2,217 90	1	25 00			44	2,292 90
Department of the Gulf.....	3	296 00	1	31 00			4	327 00
Department of the Missouri.....	319	18,268 95	145	7,588 78			464	23,857 73
Department of the Platte.....	204	10,347 07	75	4,513 50			279	14,860 57
Department of Dakota*.....								
Department of Texas.....	379	11,895 12	44	1,230 94			423	13,126 06
Department of California.....	41	1,585 88	36	1,079 28			77	2,665 16
Department of Arizona.....	39	1,438 55	101	3,229 40	2	\$100 46	142	4,768 41
Department of the Columbia.....	16	372 66	7	152 00			23	524 66
Depot of Washington.....	5	372 50					5	372 50
Depot of New York.....	3	340 00					3	340 00
Depot of Jeffersonville.....	2	46 50					2	46 50
West Point, New York.....	15	1,236 00			2	247 20	17	1,483 20
Total	1,095	47,587 77	413	18,233 90	4	347 66	1,512	66,169 33

* No reports rendered.

SUMMARY.

The following is a summary statement of the number of animals purchased, sold, died, &c., and remaining on hand during the fiscal year ending June 30, 1872.

On hand, purchased, &c.	Horses.	Mules.	Oxen.
On hand July 1, 1871.....	7,996	9,756	124
Purchased.....	3,277	209	
Taken up, &c.....	109	66	
To be accounted for.....	11,382	10,031	124
Sold.....	1,095	413	9
Died.....	371	520	5
Lost and stolen.....	187	340	
Total sold, died, &c.....	1,653	1,273	7
On hand June 30, 1872.....	9,729	8,758	117

ANNUAL ESTIMATES.

Estimates for regular and miscellaneous supplies deemed necessary for the service during the fiscal year were received from the following posts in the Military Division of the Missouri, viz: Fort Rice, Fort Shaw, Fort Stevenson, Fort Ellis, Fort Fetterman, Fort Buford, Fort Laramie, Fort Sill, Fort Snelling, Fort Wadsworth, Fort Ripley, Fort Pembina, Fort Abercrombie, Fort Totten, Fort Sully, Fort Benton, Fort Randall, Sioux City, Whetstone Agency, Cheyenne Agency, Lower Brulé Agency, Grand River Agency, Camp Baker, Santa Fé, Fort Bayard, Fort Craig, Fort Garland, Fort Selden, Fort Stanton, Fort Wingate, Fort McRae, Fort Cummings, Union Depot, and Fort Union. These estimates were carefully examined, with a view to the economical supply of only such of the articles called for as appeared necessary for the interests of the service. Purchase of the stores not on hand at the depots where the old material of the war is stored was authorized to be

made under the supervision of the chief quartermasters of the Military Division of the Missouri and of the several departments composing it.

With a view of encouraging the production of cereals and hay in the vicinity of the outlying posts, it was directed that the forage be procured as far as possible by local contracts, to be awarded in the manner prescribed by General Orders No. 57, War Department, Adjutant-General's Office, dated August 12, 1871.

REQUISITIONS.

There were received at this office during the fiscal year, and instructions given relative to the supply of the stores called for thereon, requisitions as follows :

Military Division of the Pacific	3
Military Division of the Missouri.....	65
Military Division of the South.....	89
Military Division of the Atlantic.....	44
Depot of Washington.....	25
Depot of Jeffersonville.....	2
Military Academy at West Point.....	8
Miscellaneous sources.....	2
Total	238

FIRE-EXTINGUISHERS.

Fire-extinguishers of the authorized pattern were, during the year, supplied to the following posts, viz :

Fort McPherson, Nebraska.....	4
Fort D. A. Russell, Wyoming.....	4
Fort Bridger, Wyoming.....	4
Camp Brown, Wyoming.....	2
North Platte, Nebraska.....	2
Fort Laramie, Dakota.....	3
Signal Office, Washington, D. C.....	7
Nashville, Tennessee.....	2
Fort Foote, Maryland.....	2
Fort Whipple, Virginia.....	1
Key West, Florida.....	4
Fort McIntosh, Texas.....	2
Baton Rouge, Louisiana.....	1
Fort Fetterman, Wyoming.....	4
Total	42

On the morning of March 19, 1872, a small frame building attached to the rear of the subalterns' quarters, at Camp Douglas, Utah, was found to be on fire. The building was consumed, but by the use of the extinguishers it is reported the spread of the fire was prevented, and an entire set of quarters saved from destruction.

SPRING-WAGONS.

In September, 1871, former orders were modified so as to allow, at certain frontier posts, light spring-wagons for two horses or mules, "to be used when no other suitable conveyance can be obtained for carrying the mails and transporting officers traveling under orders on public duty." Under this authority of the Secretary of War, instructions have been issued by the Quartermaster-General for the supply of a limited number of spring-wagons.

WARREN COOKERS.

The attention of the Department having been called to the patent cooker invented by Captain F. P. Warren, of the English navy, and in use by the army and navy of Great Britain, a number were purchased and supplied to the Army for practical test. The results of the trial have not as yet been fully communicated to this office.

CONTRACTS.

There were filed and examined in this office during the fiscal year 632 contracts, as follows: 243 for forage, (including bran,) embracing 11,358,576 pounds of oats or barley; 383,358 bushels of oats; 553,790 bushels of corn; 53,042 tons of hay; 14 for forage, quantities as required; 16 for both forage and fuel; 11 for straw; 20 for coal, 18,117 tons; 3 for coal, quantities as required; 114 for wood, 99,644 cords; 22 for wood, quantities as required; 34 for charcoal, 43,725 bushels; 23 for building-materials; 9 for repairing and constructing buildings; 37 for transportation; 11 for services, miscellaneous; 12 for cavalry horses, 1,961, and artillery horses 75, and mules 241; 14 for clothing, camp and garrison equipage; 5 for stationery; 20 for national cemeteries; 1 for charter; 23 for leases.

FORAGE AND STRAW,

The issues of forage and straw during the fiscal year were as follows: Corn, 709,244 bushels; oats, 886,127 bushels; barley, 170,806 bushels; hay, 54,840 tons; straw, 3,839 tons.

The issues of fuel were: Wood, 115,995 cords; anthracite coal, 17,102 tons; bituminous coal, 11,042 tons.

KIERNAN'S HINTS ON HORSESHOEING.

Under the authority of the Secretary of War, referred to in the last annual report of the Quartermaster-General, one thousand copies of this work, provided with thirty-three illustrations, designed to explain the practical workings of the system, have been distributed to the Army. Each company of cavalry and battery of artillery has been supplied with a copy, as also each quartermaster in the service. As far as known to this office the system works satisfactorily.

EXPLORING EXPEDITIONS.

The expedition under command of Lieutenant G. M. Wheeler, of the Corps of Engineers, to which reference was made in the last annual report of this office, was by authority of the Secretary of War supplied during the fiscal year with forage, animals, and miscellaneous stores by this Department. Sale of stores to the civilian employes connected with the expedition at cost price to the Government was ordered. This Department has granted every assistance at its command to facilitate the operations of the expedition.

The geological survey of the fortieth parallel, in charge of Clarence King, geologist, was also provided with means of transportation and furnished with such other necessary articles of outfit called for as within the jurisdiction of this Department to supply.

CLAIMS.

During the fiscal year the examination of miscellaneous claims, claims filed under the act of July 4, 1864, and claims and accounts for transportation, has been continued with such results as could be accomplished with the force of clerks available for the purpose. An addition of six clerks to the force now employed on duty, in connection with the examination of claims filed under the act of July 4, 1864, would be very advantageous, and is respectfully recommended. This increase of the force would enable this office to dispose of the cases more expeditiously than can now be done.

Claims filed under the act of July 4, 1864.

Six hundred and sixty-five claims, stated at \$777,337.67, filed under the act of July 4, 1864, have during the year been referred to the Third Auditor of the Treasury for settlement, at \$367,102.72, having been reduced \$410,234.95, and 274 claims have been examined and rejected, stated at \$396,100.75. The number of these claims remaining on hand at the close of the fiscal year not finally acted upon was 10,351, stated at \$6,857,006.56.

Miscellaneous claims.

Twenty-three hundred and forty-six miscellaneous claims, stated at \$538,382.22, were reduced \$32,031.51, and referred for settlement at \$506,350.71, and 312 claims, stated at \$108,668.19, were rejected. There remained on hand at the close of the fiscal year 14,485 claims, stated at \$7,558,791.75.

Transportation claims and accounts.

During the year 325 transportation accounts were referred to the Treasury Department and to disbursing officers for settlement, of \$803,171.26; 538 claims on account of transportation were referred for settlement, at \$471,998.87; and 170 claims, stated at \$1,911,722.36, have been rejected.

There remained on hand June 30, 1872, to be finally acted upon, 22 transportation accounts, stated at \$2,587.43, and 134 claims for transportation, stated at \$275,057.02. Total transportation claims and accounts on hand June 30, 1872, 156, stated at \$277,644.45.

The following is a statement of the public funds in my possession during the fiscal year:

On hand July 1, 1871.....	
Received from officers during the year.....	\$71 09
Received from the Treasury Department.....	
Received from sales of railway property.....	118,294 47
Received from other sources.....	
Total received during the year.....	118,365 56
Disbursed during the year.....	
Transferred to other officers.....	
Deposited to the credit of the Treasury of the United States during the year.....	\$118,365 56
Remaining on hand June 30, 1872.....	
Total.....	118,365 56

For information in detail on the several subjects of this report see the papers submitted herewith, as follows:

A.—Statement of the indebtedness to the United States of southern railroad companies on account of purchase of railway material for the fiscal year.

B.—Abstract of contracts made by officers of the Quartermaster's Department for water-transportation.

C.—Table of land-grant railroads.

D.—Abstract of contracts made by officers of the Quartermaster's Department for wagon-transportation during the fiscal year.

E.—Statement of vessels chartered and employed by officers of the Quartermaster's Department during the fiscal year.

F.—Statement of vessels owned or purchased by the Quartermaster's Department during the fiscal year.

G.—Statement of all troops and stores transported under direction of the Quartermaster's Department during the fiscal year.

H.—Statement of amounts paid by the Quartermaster's Department on account of rail, river, wagon, and stage transportation during the fiscal year.

I.—Statement of accounts and claims at this office on account of transportation for the fiscal year.

K.—Statement of claims filed at this office under the act of July 4, 1864, for the fiscal year.

L.—Statement of miscellaneous claims filed at this office for the fiscal year.

Very respectfully, your obedient servant,

M. I. LUDINGTON,

Quartermaster, United States Army.

Brigadier-General M. C. MEIGS,

Quartermaster General United States Army.

A.—Statement of the indebtedness of certain railway companies for railway material and rolling-stock purchased under provisions of executive orders of August 8 and October 14, 1868, and orders of the Quartermaster-General, United States Army, for the year ending June 30, 1872.

Number.	Name of company indebted to the United States July 1, 1871.	Value of property sold.	Interest on same to June 30, 1872.	Total expenses to June 30, 1872.	Total principal, in- terest, and ex- penses to June 30, 1872.	Balance of princ- pal unpaid July 1, 1871.	Balance of interest unpaid July 1, 1871.	Expenses unpaid July 1, 1871.	Total principal, in- terest, and ex- penses unpaid July 1, 1871.
1	Alexandria, Loudoun and Hampshire.	\$62,392 96	\$20,237 13	\$75 73	\$3,003 82	\$11,836 10	\$123 10		\$11,959 20
2	Alabama and Florida.	27,109 04	12,467 31	543 01	27,109 04	11,360 41			11,360 41
3	Alabama and Chattanooga.	30,243 32	12,467 31	543 01	43,338 86	17,461 43	870 18		18,337 63
4	East Tennessee and Georgia.	306,183 02	100,986 77	9,322 73	525,492 32	336,447 38	28,357 93		376,005 31
5	East Tennessee and Virginia.	265,635 63	116,960 07	2,322 73	384,484 43	249,228 81	3,919 43		283,148 54
6	Edenfield and Kentucky.	114,772 86	55,829 54	1,745 00	172,347 40	114,772 86	43,562 38	\$1,145 00	161,480 44
7	Indiana.	20,000 00			20,000 00	13,000 00			13,000 00
8	Knoxville and Kentucky.	12,335 63	4,283 86	151 27	16,738 76	9,544 89	396 77		10,141 66
9	McMinnville and Manchester.	46,508 54	21,062 17	2,715 20	70,315 91	46,508 54	17,654 02	2,175 20	66,337 76
10	Mississippi, Gainesville and Tuscaloosa.	33,476 39	16,381 67	67 73	49,925 81	33,476 39	4,148 87		37,619 26
11	Mobile and Ohio.	565,143 70	80,365 69		645,409 39	74,269 05	7,397 19		81,666 24
12	Mississippi and Tennessee.	127,730 52	30,207 81		157,938 33	16,240 52	120 18		16,360 70
13	Memphis, Clarksville and Louisville.	336,932 36	163,045 99	1,845 00	501,823 35	336,932 36	106,735 30	400 00	444,067 66
14	Memphis and Ohio.	106,929 13	22,997 78		129,927 91	11,840 38	357 58		12,197 96
15	Memphis and Little Rock.	133,673 69	46,647 95	75 40	200,397 24	78,083 84	2,467 73		80,551 59
16	Nashville and Chattanooga.	1,566,551 73	615,631 70	2,334 12	2,184,417 53	1,474,206 55	33,135 86		1,507,332 41
17	Nashville and North-western.	525,400 86	239,656 28	2,334 11	767,390 65	521,192 58	173,962 23	566 06	701,730 87
18	Nashville and Decatur.	405,193 02	144,407 99	3 35	549,604 36	250,820 10	40,245 73		321,340 18
19	New Orleans and Ohio.	32,150 00	13,719 95	4,647 30	50,517 15	27,961 19	5,993 13	1,114 99	35,038 31
20	Pacific Railroad of Missouri.	125,433 63			125,433 63	11,715 57			11,715 57
21	South-west branch of Pacific Railroad of Missouri.	57,115 24			57,115 24	56,115 24			56,115 24
22	Seima, Rome and Dalton.	183,276 40		53 95	239,698 12	140,549 20	1,636 48		142,185 68
23	Washington, Alexandria and Georgetown.	324 06	76,367 68		324 06	217 61			217 61
	Total.	5,104,757 56	1,861,099 34	21,495 57	6,987,355 47	3,290,231 62	828,443 31	5,675 00	4,794,503 33

A.—Statement of the indebtedness of certain railroad companies for railway material and rolling-stock, &c.—Continued.

Number.	Name of company indebted to the United States July 1, 1871.	Expenses unpaid.	Balance principal 1872. unpaid July 1.	Total principal, in- terest, and ex- penses unpaid July 1, 1872.	Terms of payment—Remarks.
1	Alexandria, Loudonn and Hampshire.....	.....	\$9,335 89	\$9,451 64	Due June 30, 1865, \$45,000; first mortgage bonds deposited as collateral.
2	Alabama and Florida.....	.....	11,380 81	11,380 81	Transportation accounts filed sufficient to liquidate the debt.
3	Alabama and Chattanooga.....	\$419 05	17,861 45	50,485 57	Due April 30, 1871.
4	East Tennessee and Georgia.....	.....	350,447 58	379,051 30	Companies consolidated. Debts compromised by Secretary of War un- der act of March 3, 1871, for \$195,000; \$5,000 cash; balance, one-half in ten and one-half in fifteen years from June 1, 1872, with interest of 4 per cent. per annum, payable semi-annually.
5	East Tennessee and Virginia.....	.....	949,298 81	954,487 75	Due October 31, 1870.
6	Edgfield and Kentucky.....	1,745 00	114,772 86	170,481 81	Payable in transportation.
7	Indiana.....	.....	15,000 00	15,000 00	Due August 30, 1869. Suit pending.
8	Knoxville and Kentucky.....	.....	9,544 89	10,119 36	Due July 1, 1869. Suit pending.
9	McMinnville and Manchester.....	9,775 30	46,508 54	70,348 16	Due August 31, 1869. Company bankrupt.
10	Mississippi, Gainesville and Tuscaloosa.....	.....	33,476 39	40,069 72	Due July 31, 1871.
11	Mobile and Ohio.....	.....	74,969 05	87,101 88	\$1,500 payable monthly.
12	Mississippi and Tennessee.....	.....	7,861 15	7,925 61	Due October 31, 1869.
13	Memphis, Clarksville and Louisville.....	50 00	336,932 36	454,613 37	Debt discharged October 27, 1871.
14	Memphis and Ohio.....	.....	76,769 92	81,637 11	Interest and \$1,000 payable monthly in money; postal and transporta- tion service to be credited.
15	Memphis and Little Rock.....	.....	.....	.....	Compromised, by Secretary of War under act of March 3, 1871, for \$1,000,000, payable one-half in ten and one-half in twenty years from June 1, 1871, with interest at 4 per cent. per annum.
16	Nashville and Chattanooga.....	.....	1,474,906 55	1,835,574 89	Due November 30, 1870. Suit pending.
17	Nashville and Northwestern.....	.....	521,199 58	728,173 95	Due April, 1870. Suit pending.
18	Nashville and Decatur.....	874 35	260,820 10	341,896 18	Company bankrupt. Nothing further can be collected.
19	New Orleans and Ohio.....	.....	25,788 87	25,788 87	Payable in transportation; one-half to be applied.
20	Pacific Railroad of Missouri.....	.....	4,611 94	4,611 94	\$1,000 payable monthly in money until October 1, 1872; thence \$2,000 un- til October, 1873; thence \$3,000 until debt is paid. Postal and trans- portation service to be credited.
21	Southwestern branch Pacific Railroad of Missouri.....	.....	56,115 24	56,115 24	Debt discharged August 16, 1871.
22	Salina, Rome and Dalton.....	.....	128,540 37	130,134 27	.....
23	Washington, Alexandria and Georgetown.....	.....	.....	.....	.....
	Total.....	5,263 60	3,844,665 35	4,734,442 43	.....

The following-named companies have discharged their indebtedness to the United States.

Number.	Name of company.	Value of property sold.	Interest on same to June 30, 1872.	Total expense to June 30, 1872.	Total principal, interest, and expenses, 1872.	Total payments made to July 1, 1872.	Remarks.
1	Richmond, Fredericksburgh and Potomac.	\$7,449 27	.....	.....	\$7,449 27	\$7,449 27	Debt discharged January 1, 1866.
2	Georgia Railroad and Banking Company	11,525 05	.....	.....	11,525 05	11,525 05	Debt discharged January 13, 1866.
3	Southwestern	46,139 89	.....	.....	46,139 89	46,139 89	Debt discharged May 4, 1866.
4	Macon and Western.	83,038 13	.....	.....	83,038 13	83,038 13	Debt discharged November 24, 1866.
5	South Carolina.	23,436 50	.....	.....	23,436 50	23,436 50	Debt discharged January 31, 1867.
6	Alauegoe.	3,344 30	\$1,646 76	.....	3,408 77	3,408 77	Debt discharged May 15, 1867.
7	Petersburgh.	65,000 00	3,424 57	.....	68,424 57	68,424 57	Debt discharged August 22, 1867.
8	Memphis and Charleston.	547,494 09	3,633 60	.....	578,353 73	578,353 73	Debt discharged August 22, 1867.
9	Mobile and Great Northern.	14,677 73	30,269 64	.....	15,530 98	15,530 98	Debt discharged October 16, 1867.
10	New Orleans, Jackson and Great Northern.	14,677 73	1,192 35	.....	15,530 98	15,530 98	Debt discharged October 31, 1867.
11	Mississippi Central.	200,865 58	15,636 91	.....	216,522 49	216,522 49	Debt discharged February 20, 1868.
12	Montgomery and Tennessee.	78,480 00	6,368 56	.....	84,828 56	84,828 56	Debt discharged April 11, 1868.
13	Virginia and West Point.	102,880 00	14,371 05	.....	117,251 05	117,251 05	Debt discharged April 16, 1868.
14	Virginia Central.	38,559 66	3,324 93	.....	41,884 59	41,884 59	Debt discharged July 16, 1868.
15	Western and Atlantic.	70,000 00	10,364 66	.....	80,364 66	80,364 66	Debt discharged July 31, 1868.
16	Rome.	32,096 05	1,778 57	.....	33,864 62	33,864 62	Debt discharged August 10, 1868.
17	Orange and Alexandria.	478,944 66	70,194 71	.....	543,139 37	543,139 37	Debt discharged August 27, 1868.
18	Mannassas Gap.	116,885 74	13,497 44	.....	131,383 18	131,383 18	Debt discharged October 3, 1868.
19	Wilmington and Weldon.	4,023 51	864 87	.....	5,488 38	5,488 38	Debt discharged October 8, 1868.
20	Alabama and Florida.	81,500 00	9,946 31	.....	91,446 31	91,446 31	Debt discharged November 4, 1868.
21	New Orleans, Opelousa and Great Western.	51,912 00	6,355 18	.....	58,267 18	58,267 18	Debt discharged May 31, 1869.
22	Norfolk and Petersburg.	113,773 45	11,947 35	.....	125,720 80	125,720 80	Debt discharged August 31, 1869.
23	Western North Carolina.	2,119 00	.....	.....	2,119 00	2,119 00	Debt discharged January 11, 1870.
24	Atlantic and North Carolina.	14,989 82	2,064 08	\$48 00	16,401 90	16,401 90	Debt discharged June 6, 1870.
25	Macon and Brunswick.	51,453 93	11,040 15	61 80	62,494 08	62,494 08	Debt discharged July 31, 1870.
26	Selma and Meridian.	26,890 00	4,591 44	31,743 34	31,743 34	31,743 34	Debt discharged January 25, 1871.
27	San Antonio and Mexican Gulf.	146,397 92	23,836 79	568 00	170,832 71	170,832 71	Debt discharged June 13, 1871.
	Total.	46,775 19	17,048 49	4 25	63,827 93	63,827 93	Debt discharged June 14, 1871.
	Total.	2,451,376 39	360,498 61	688 05	2,712,367 05	2,712,367 05	

I certify the above statement to be correct.

M. L. LUDINGTON,
Major and Quartermaster, United States Army,
In charge of railroad indebtedness.

B.—Abstract of contracts for water-transportation entered into by the Quartermaster's Department during the fiscal year ending June 30, 1872.

Names of officers.	Names of contractors.	Date of contract.	Route of supply.	Rates.	Date of expiration of contract.
Major R. Saxton, quartermaster U. S. A.	J. H. D. Gray	July 1, 1871	Astoria to Fort Stevens, Oregon, and Cape Disappointment, Wash.	\$450 a month, \$6 an hour, and \$30 for each extra trip, in coin.	June 30, 1872
Major R. Saxton, quartermaster U. S. A.	Thomas Coupe	July 1, 1871	Transportation of military mules between Port Townsend and Camp San Juan, Wash.	\$300 per month for mules and passengers, and \$5 per ton for stores.	June 30, 1872
Lt.-Col. J. A. Ekin, deputy quartermaster-general.	Kenedy & King	July 1, 1871	Transportation of stores from Brazos Santiago, to Fort Brown and Ringgold Barracks, Texas.	Schedule rates	June 30, 1872
Lt.-Col. J. A. Ekin, deputy quartermaster-general.	Kenedy & King	July 1, 1871	Transportation of officers and men from Brazos Santiago to Fort Brown and Ringgold Barracks, Texas.	Schedule rates	June 30, 1872
Lt.-Col. J. A. Ekin, deputy quartermaster-general.	C. A. Whitney & Co., agents Chas. Morgan.	July 1, 1871	New Orleans, Louisiana, to Galveston, Brazos Santiago, and Indianola, Texas.	Schedule rates	June 30, 1872
Col. D. H. Knott, assistant quartermaster-general.	Grant Marsh	March 1, 1872	Sioux City to Fort Benton and intermediate points on the Missouri River.	Schedule rates	October 31, 1872
Major Wm. Myers, quartermaster U. S. A.	Thomas Stackpole	July 1, 1871	Washington, D. C., to Forts Foote and Washington, Maryland.	Schedule rates	June 30, 1872
Major C. G. Sawtelle, quartermaster U. S. A.	Geo. A. Johnson & Co ..	July 1, 1871	San Francisco, California, to Port Isabel, Colorado River.	\$12.50 per ton, in coin	June 30, 1872

Correct.

M. I. LUDINGTON, Quartermaster, United States Army.

C.—Table of land-grant railroads.

[CIRCULAR.]

The following table of land-grant railroads in the United States, compiled from the statutes of the United States, records of the General Land-Office, and other official sources, is published for the information of all concerned.

No.	Present names of companies owning or operating the roads.	Original names of companies to which grants were made.	States or corporation.	Termini of land-grant portion.		Remarks.
				From—	To—	
					Miles.	
1	Alabama and Chattanooga...	Will's Valley and Northeast and Southwest.	Alabama	Wauhatchie, Tenn.	State line Miss.—Ala.	Deduct 33½ per cent. from tariff rates.
2	Atchison, Topeka and Santa Fe.	Atchison, Topeka and Santa Fe.	Kansas	Atchison, Kan.	The State line.	Do.
3	Atlantic and Pacific	Atlantic and Pacific, with a branch from the Canadian River to western boundary of Arkansas at or near Van Buren, Arkansas.	Corporation	Springfield, Mo., via Canadian River, Atchison, and the Colorado River.	The Pacific Ocean.	Full payments may be made to the company.
4	do	Southwest Branch Pacific Railroad of Missouri.	Missouri	Saint Louis, Mo.	Springfield, Mo.	Deduct 33½ per cent. from tariff rates.
5	Burlington and Missouri River.	Burlington and Missouri River.	Iowa	Burlington, Iowa.	Missouri River.	Do.
6	Chicago and Northwestern—	Cedar Rapids and Missouri River.	Nebraska	Plattsmouth, Neb.	Fort Kearney, Neb.	Do.
7	Chicago and Northwestern—	Chicago, Saint Paul and Fond du Lac.	Iowa	Clinton, Iowa.	Missouri River, Iowa.	Do.
8	Chicago and Northwestern—	Chicago, Saint Paul and Fond du Lac.	Wisconsin	Fond du Lac, Wis.	Wisconsin State line.	Do.
9	Chicago, Rock Island and Pacific.	Bay de Noc and Marquette.	Michigan	Wisconsin State line.	Marquette, Mich., via Escanaba.	Do.
10	Central Pacific—main line.	Mississippi and Missouri Pacific Railroad.	Iowa	Davenport, Iowa.	Missouri River.	Do.
11	Central Pacific—western division.	Western Pacific.	Corporation.	Ogden.	Sacramento, Cal.	Fifty per cent. to be retained by the United States.
12	Central Pacific—Oregon division.	California and Oregon.	do	Sacramento, Cal.	San Francisco, Cal.	Do.
13	Central Branch Union Pacific	Atchison and Pike's Peak.	California and Oregon Corporation.	Junction with Central Pacific.	Portland, Oregon.	No payment should be made for transportation over this road.
14	Cairo and Fulton.	Cairo and Fulton.	Missouri and Arkansas.	Atchison, Kan.	Waverly, Kans.	Fifty per cent. to be retained by the United States.
15	Denver Pacific.	Kansas Pacific.	Corporation	Mississippi River, opposite Cairo, via Little Rock, Ark.	Texas boundary, near Fulton, Ark.	No payment should be made for transportation over this road.
16	Florida.	Florida.	Florida	Denver	Cheyenne	Full payments may be made to this company.
17	Flint and Pere Marquette.	Flint and Pere Marquette.	Michigan	Fernandina, Fla.	Cedar Keys	Deduct 33½ per cent. from tariff rates.
				Flint, Mich.	Lake Michigan, Mich.	Do.

18	Grand Rapids and Indiana..	Indiana and Michigan.	Fort Wayne, Ind.....	Traverse Bay, Mich.....	Deduct 33½ per cent from tariff rates.
19	Hannibal and Saint Joseph..	Missouri.....	Hannibal, Mo.....	Saint Joseph, Mo.....	Do.
20	Hastings and Dakota.....	Minnesota.....	Hastings.....	Western boundary of the State.	No payments should be made for transportation over this road.
21	Illinois Central—main line..	Illinois.....	Calro, Ill.....	Dunleith, Ill.....	Deduct 33½ per cent from tariff rates.
22	Illinois Central—Chicago Branch..	do.....	do.....	Chicago, Ill.....	Do.
23	Illinois Central—Iowa division.	Iowa.....	Dubuque.....	Stout City.....	Do.
24	Jackson Landing and Saginaw..	Michigan.....	Amboy, Mich.....	Straita of Mackinaw.....	No payments should be made for transportation over this road.
25	Jacksonville, Pensacola and Mobile.	Florida.....	Jacksonville, Fla.....	Quincy, Fla.....	Deduct 33½ per cent from tariff rates.
26	Kansas Pacific.....	Corporation..	Kansas City, Mo.....	Denver, Col.....	Fifty per cent to be retained by the United States.
27	Little Rock and Fort Smith..	Arkansas.....	Little Rock, Ark.....	Fort Smith, Ark.....	No payments should be made for transportation over this road.
28	Lake Superior and Mississippi.	Minnesota.....	Saint Paul, Minn.....	Du Luth, Minn.....	Deduct 33½ per cent from tariff rates.
29	Leavenworth, Lawrence and Galveston.	Kansas.....	Leavenworth, Kan.....	South line of State.....	Do.
30	Mobile and Ohio.....	Alabama and Mississippi.	Mobile, Ala.....	Columbus, Ky.....	Do.
31	Mobile and Montgomery.....	Alabama.....	Montgomery, Ala.....	Pellard, Ala.....	Do.
32	Mobile and Girard.....	do.....	Columbus, Ala.....	Troy, Ala.....	Do.
33	Memphis and Little Rock..	Arkansas.....	Mississippi River.....	Little Rock, Ark.....	No payments should be made for transportation over this road.
34	Marquette and Ontonagon..	Michigan.....	Marquette, Mich.....	Ontonagon, Mich.....	Deduct 33½ per cent from tariff rates.
35	Missouri, Kansas and Texas.	Kansas.....	Junction City, Kan.....	Southern boundary of Kansas, and to Fort Smith when the Indian title is extinguished.	No payments should be made for transportation over this road.
36	Missouri River, Fort Scott and Gulf.	do.....	Kansas City, Mo.....	South line of Kansas..	Do.
37	Milwaukee and Saint Paul— Iowa and Minnesota division.	Minnesota.....	(Saint Paul via Mendota, Fairbault, and Austin. Minnesota via Fairbault, Mendota, and Austin.	Lyle, Minn.....	Deduct 33½ per cent from tariff rates.

* See Railway Guide—Iowa Midland Railroad.

† Branch road commences at Centralia.

‡ That portion of the Jackson, Lansing and Saginaw Railroad between Jackson and Lansing is not a land-grant railroad.

§ See Railway Guide, Iowa and Dakota division, for distance from Austin to Lyle.

|| NOTE.—For distance from Plattsmouth, Nebraska, to Fort Kearney, Nebraska, or to end of completed road, see Railway Guide.

Operated by Michigan Central Railroad Company.

C.—Table of land-grant railroads—Continued.

Number.	Present names of companies owning or operating the roads.	Original names of companies to which grants were made.	States or corporation.	Terminals of land-grant portion.			Remarks.
				From—	To—	Miles.	
38	Milwaukee and Saint Paul— Iowa and Dakota division.	McGregor and Sioux City, and McGregor and Mis- souri River.	Iowa	Calmar, Iowa.....	Junction with Saint Paul and Sioux City Railroad.	.....	Deduct 33½ per cent from tariff rates.
39	Milwaukee and Saint Paul— La Crosse division.	La Crosse and Milwaukee ..	Wisconsin ..	Portage City, Wis.....	Tomah, Wis.....	68	Do.
40	Morgan's, Louisiana and Texas.	New Orleans, Opelousas, and Great Western.	Louisiana ..	New Orleans, La.....	Brashear, La.....	80	Do.
41	North Louisiana and Texas..	Vicksburg, Shreveport, and Texas.	.....do	Delta, La.....	Monroe	73	Do.
42	New Orleans, Baton Rouge, and Vicksburg.	New Orleans, Baton Rouge, and Vicksburg.	Corporation ..	New Orleans, La.....	Texas State line.....	.....	Full payments may be made to this company.
43	Northern Pacific.....	Northern Pacific, with a branch via Columbia River to a point near Portland, Oregon.	.....do	Lake Superior.....	Puget Sound .....	.....	Do.
43½	Oregon and California.....	Oregon and California.....	Oregon.....	Portland	South boundary of State.	.....	No payments should be made for transportation over this road.
44	Oregon Central.....	Oregon Central, with a branch from Fort Grove to Yamhill River, near Mo- minville.	.....do .....	.....do	Astoria and McMinn- ville.	.....	Full payments may be made to this company.
45	Pensacola and Louisville.....	Alabama and Florida.....	Florida.....	Pensacola, Fla.....	Pollard, Ala.....	44	Deduct 33½ per cent from tariff rates.
46	Pacific Railroad of Missouri*	Southwest Branch Pacific Railroad of Missouri.	Missouri ..	Saint Louis, Mo.....	Franklin, Mo.....	37	Do.
47	Placerville and Sacramento Valley.	Placerville and Sacramento Valley.	California ..	Folsom, Cal.....	Placerville, Cal.....	.....	No payments should be made for transportation over this road.
48	South and North Alabama... Valley.	Tennessee and Alabama Cen- tral.	Alabama.....	Montgomery, Ala.....	Decatur, Ala.....	.....	Deduct 33½ per cent from tariff rates.
49	Selma, Rome, and Dalton ..	Alabama and Tennessee, Cocoa and Tennessee.	.....do	Selma, Ala.....	11 miles north of Jack- sonville, Ala.	156	Do.
50	Saint Louis and Iron Mount- ain.	Saint Louis and Iron Mount- ain.	Missouri and Arkansas.	Pilot Knob, Mo.....	Helena, Ark.....	.....	No payments should be made for transportation over this road.
51	Saint Paul and Sioux City...	Minnesota Valley	Iowa and Min- nesota.	Saint Paul, Minn.....	Sioux City, Iowa.....	.....	Deduct 33½ per cent from tariff rates.
52	Sioux City and Pacific.....	Sioux City and Pacific	Iowa and Ne- braska.	Sioux City, Iowa.....	Fremont, Neb.....	.....	Fifty per cent to be retained by the United States.
53	Saint Paul and Pacific, (main line.)	Saint Paul and Pacific.....	Minnesota ..	Stillwater, via Saint Paul.	Breckenridge, Minn ..	113	Deduct 33½ per cent from tariff rates.
54	Saint Paul and Pacific, (br.)	Saint Paul and Pacific.....	.....do	Stillwater, via Saint Paul and Crow Wing.	Northern Pacific Rail- road.	.....	Do.

* Junction with Atlantic and Pacific Railroad, Franklin, Missouri.

55	Saint Paul and Pacific, (br.)	Saint Paul and Pacific.	Minnesota	Stillwater, via Saint Paul and Saint Cloud.	Pemba.	Deduct 33 per cent from tariff rates.
56	Saint Joseph and Denver City.	Northern Kansas.	Kansas.	Elwood, Kans.	Junction with Union Pacific Railroad.	Full payments may be made to this company.
57	Stockton and Copperopolis.	Stockton and Copperopolis.	California.	Stockton, Cal.	Copperopolis, Cal.	No payments should be made for transportation over this road.
58	Southern Pacific of California	Southern Pacific of California	do	San Francisco, Cal.	Some point on the Atlantic and Pacific Railroad near the boundary line of California.	Full payments may be made to this company.
59	Southern Pacific of California (branch line.)	do	Corporation	From a point near Tehachapa Pass, via Los Angeles.	Texas Pacific Railroad near the Colorado River.	Do.
60	Southern Minnesota.	Root River Valley, and Southern Minnesota.	Minnesota	Mississippi River, opposite La Crosse.	Western boundary of the State.	No payments should be made for transportation over this road.
61	Texas and Pacific.	Texas Pacific.	Corporation	From a point near Marshall, Texas, via El Paso, to southern boundary of California, thence—	San Diego, Cal.	Full payments may be made to this company.
62	Utah Central.	Utah Central.	Territory of Utah.	Ogden, Utah.	Salt Lake City, Utah.	Do.
63	Union Pacific	Pacific	Corporation	Omaha, Neb.	Ogden, Utah	Fifty per cent. to be retained by the United States.
64	Vicksburgh and Meridian.	Southern Mississippi.	Mississippi	Jackson, Miss.	Meridian, Miss.	Deduct 34 per cent from tariff rates.
65	Winona and Saint Peter.	Winona and Saint Peter.	Minnesota	Winona, Minn.	A point on the Big Sioux River.	Do.
66	West Wisconsin	Tomah and Lake Superior.	Wisconsin	Tomah, Wis.	Hudson, Wis.	Do.
67	Wisconsin Central	Portage, Winnebago, and Lake Superior.	do	Portage City, via Stevens Point.	Bayfield, thence to Lake Superior.	Do.

Official:

QUARTERMASTER-GENERAL'S OFFICE, Washington, D. C., February 29, 1878.

ROBT. ALLEN,
Acting Quartermaster-General.
M. I. LUDINGTON,
Quartermaster, United States Army.

D.—Abstract of contracts for wagon-transportation entered into by the Quartermaster's Department during and for the fiscal year ending June 30, 1872.

Names of officers.	Names of contractors.	Date of contract.	Route of supply.	Rates.	Date of expiration of contract.
Captain R. C. Card, acting chief quartermaster, Department of Texas, San Antonio.	Galveston, Houston, and Henderson R. R., Robert Colwell, manager.	July 1, 1871	From Ship's Tankle, at Galveston, to Bremond or the terminus of the railroad.	58 cts. per 100 lbs. per 100 miles.	June 30, 1872
Major Rufus Saxton, chief quartermaster, Department of Columbia, Portland, Oregon.	J. M. Stephenson & Co	May 15, 1871	From Wallula, Wash., to Fort Boise, Idaho, 250 miles.	\$2.50 per 100 lbs. for entire distance.	June 30, 1872
Capt. H. W. James, assistant quartermaster, Portland, Oregon.	Andrew Cronly	Sept. 3, 1871	Carrying the mail between Camp Warner, Oreg., and Camp Bidwell, Cal.	\$1.49 coin per month	June 30, 1872
Do	A. J. Brown	Dec. 19, 1871	Carrying the mail between Yreka, Cal., and Fort Klamath, Oreg.	\$1.60 coin per month	June 30, 1872
Lt.-Col. S. B. Holabird, chief quartermaster, Department of Dakota, Saint Paul, Minnesota.	R. G. Terry	Aug. 19, 1871	Carrying the mail and express between Forts Stevenson and Buford, Dak.	\$2.95 per month	Oct. 1, 1872
Do	N. P. Clarke and Samuel Mayall	Aug. 21, 1871	For the transportation of at least 43 tons of public, military, or other stores, going with and accompanying a military escort to a surveying party of civil engineers of the Northern Pacific R. R., moving and encamping, going and coming, in such manner as the commanding officer or quartermaster of the escort shall direct, from September 6, 1871, until the end of the trip.	\$14 per ton per day from the time of starting from Fort Rice, Dak., until the return of the escort to the same place or one equally distant from Fort Wadsworth, Dak.	Date of the return of the escort at Fort Rice, or to a point equally distant from Fort Wadsworth, Dak.
Do	James Richmond	Aug. 24, 1871	Carrying the mail and express between Forts Stevenson and Rice, Dak.	\$175 per month	Oct. 1, 1872
Do	William Hudnell	Mar. 4, 1872	Between all points now or which may be established in Montana Territory between April 1, 1872, and March 31, 1873.	\$1.05 per 100 lbs. per 100 miles.	Mar. 31, 1873
Do	N. P. Clarke	Feb. 14, 1872	From Saint Paul, Saint Cloud, and other points in Minnesota and Dakota, to any post in Minnesota and Dakota.	\$1.23 per 100 lbs. per 100 miles.	Mar. 31, 1873
Lt.-Col. L. C. Easton, chief quartermaster, Department of the Missouri, Fort Leavenworth, Kansas.	W. C. Graham	Aug. 22, 1871	From Saint Louis and Fort Leavenworth to Fort Sill, Idaho, and Forts Richardson and Griffin, Texas.	From Saint Louis, \$4.15, \$5.05, and \$6.25 per 100 lbs. respectively, from Fort Leavenworth, \$4.10, \$5, and \$6.20 per 100 lbs., respectively, \$3.85, \$4.72, and \$6.23 per 100 lbs., respectively.	Mar. 31, 1872
Do	J. R. Barrett	Mar. 20, 1872	do	\$1.17 per 100 lbs. per 100 miles, average rate for the year.	Dec. 31, 1872
Do	E. B. Allen	Mar. 26, 1872	From any points on the Kansas Pacific Railway, Atchison, Topeka, and Santa F6 R. R., and Denver and Rio Grande R. R., to any point in the State of Kansas and Territories of Colorado.		Mar. 31, 1873

QUARTERMASTER-GENERAL.

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Captain G. C. Smith, assistant quartermaster, San Francisco, Cal.	Smith & Cutter	Aug. 28, 1871	do, New Mexico, and Arizona, and in such portions of Indian Territory and the State of Texas as lie north of the Red River and west of longitude 97°; also from any intermediate points on the routes to the same places.	Various rates.	June 30, 1873
Major C. G. Sawtelle, chief quartermaster, Department of California.	Ellis & Co.	June 1, 1873	From San Francisco to Camp Wright, Cal., 192 miles.	\$5.94 per 100 lbs. for entire distance, (average.)	June 30, 1873
Do.	Sigmond Greenbaum	June 1, 1873	From San Francisco to Camp Gaston, Cal., 280 miles.	\$3.15 5-12 per 100 lbs. for entire distance, (average.)	June 30, 1873
Do.	J. S. Rothechild	June 1, 1873	From San Francisco to Camp Independence, Cal., 683 miles.	\$7.08 5-12 per 100 lbs. for entire distance, (average.)	June 30, 1873
Do.	J. & G. W. Stanley	June 1, 1873	From Corinne, Utah, to Fort Hall, Idaho, 140 miles.	\$2.10 per 100 lbs. for whole distance.	June 30, 1873
Do.	Whitney & Co.	June 25, 1873	From Reno, Nev., to Camp Warner, Oreg., 312 miles.	\$7.50 per 100 lbs. for whole distance.	Oct. 20, 1873
Do.	do	June 13, 1873	From Reno, Nev., to Camp Bidwell, Cal., 268 miles.	\$6.10 per 100 lbs. for whole distance.	Oct. 31, 1873
Lt. Col. R. O. Tyler, chief quartermaster Military Division of the Pacific, San Francisco, Cal.	David Neahr	July 28, 1871	From Yuma Depot, Cal., to Tucson, Ariz., 275 miles; Camp Grant, Ariz., 268 miles; Camp Crittenden, Ariz., 236 miles; Camp McDowell, Ariz., 222 miles; Camp Bowie, Ariz., 380 miles; Camp Pinal, Ariz., 390 miles; Camp Apache, Ariz., 491 miles.	\$2 per 100 lbs. per 100 miles.	June 30, 1873
Do.	J. M. Barney	Aug. 19, 1871	From Ehrenberg, Ariz., to Camp Hualpai, 204 miles; Camp Date Creek, 117 miles; Camp Verde, 216 miles; Camp Whipple, 177 miles.	To Camp Hualpai \$2.85 per 100 lbs. per 100 miles; to the other posts \$2.75 per 100 lbs. per 100 miles.	June 30, 1873
Major A. R. Eddy, chief quartermaster Department of the South, Louisville, Ky.	G. M. Martin	July 1, 1871	Drayage in and about the city of Charleston, S. C.	Various rates.	June 30, 1873
Lt. Col. Jas. A. Ekin, chief quartermaster Department of Texas, San Antonio.	A. T. Smith Adams & Wicks	Sept. 27, 1871 June 3, 1871	Drayage in and about the city of Savannah, Ga., from Indiana or the terminus of the Mexican Gulf R. R. to San Antonio, Tex.	do	June 30, 1873 June 30, 1873
Do.	do	June 3, 1871	From San Antonio to Fort Clarke, 198 miles; Concho, 215 miles; Davis, 466 miles; Duncan, 155 miles; Griffin, 305 miles; McIntosh, 165 miles; McKavett, 175 miles; Richardson, 330 miles; Stockton, 394 miles.	\$1.23 per 100 lbs. per 100 miles.	June 30, 1873
Do.	do	June 3, 1871	From Bremond to Fort Griffin, 268 miles; to Fort Richardson, 191 miles.	\$2.23 per 100 lbs. per 100 miles.	June 30, 1873

Respectfully submitted.

M. I. LUDINGTON, Quartermaster, United States Army.

E.—Statement of vessels chartered, impressed, or employed by the Quartermaster's Department during the fiscal year ended June 30, 1872.

Name.	Class.	Tonnage.	When chartered.	Period of service.		Where charter-money is payable.	By whom put in service.	Rate of pay.	Amount paid.	Amount unpaid.	Total incurred.	Expenses for coal, &c.
				From—	To—							
U. S. Grant	Steamer	.....	July 1, 1871	July 1, 1871	June 30, 1872	Portland, Oreg.	Maj. R. Saxton, Q. M.	\$450 a mo.*	\$6,246 42	.....	\$6,246 42	.....
Unknown	do	.....	July 1, 1871	July 1, 1871	June 30, 1872	do	do	\$300 a mo.	3,600 00	.....	3,600 00	.....
Henry Smith	do	108	June 1, 1869	July 1, 1871	June 30, 1872	New York City	Col. Rufus Ingalls, Q. M.	\$45 a day	16,470 00	.....	16,470 00	.....
Florence	do	.....	Oct. 15, 1871	Oct. 15, 1871	Oct. 18, 1871	do	do	\$200 a day	800 00	.....	800 00	.....
Pope Catlin	do	.....	Dec. 5, 1871	Dec. 5, 1871	54 hours	do	do	\$10 an hour	52 50	.....	52 50	.....
Thos. Riley	do	118 11-95	Dec. 5, 1871	Dec. 5, 1871	3, 1873	do	do	\$80 a day	80 00	.....	80 00	.....
Propeller	do	67	July 18, 1871	July 18, 1871	Sept. 27, 1871	San Francisco, Cal.	Capt. G. C. Smith, A. Q. M.	\$600 a mo.	1,400 00	.....	1,400 00	.....
Lookout	Barge	.....	July 18, 1871	July 18, 1871	Sept. 13, 1871	do	do	\$100 a mo.	189 99	.....	189 99	.....
Not named.	Flat-boat	.....	Mar. 1, 1872	Mar. 1, 1872	Apr. 1, 1872	Mobile, Ala.	do	\$110 a mo.	915 00	.....	915 00	.....
Neptune	do	.....	Mar. 22, 1872	For round trip	.....	do	Lt. James Miller, 3d Infantry, A. A. Q. M.	\$15 a day	160 00	.....	160 00	.....
Thistle	Schooner	100	June 12, 1872	For round trip	.....	do	Lt. James Miller, 3d Infantry, A. A. Q. M.	.....	90 00	.....	90 00	.....
Elvira	do	60	Oct. 18, 1871	Oct. 18, 1871	Oct. 18, 1871	Savannah, Ga.	Lt. C. A. H. McConey, 3d Artillery, A. A. Q. M.	\$75 a voyage.	75 00	.....	75 00	.....
Christiana	Steamer	.....	Dec. 9, 1871	Dec. 9, 1871	Dec. 9, 1871	do	Lt. C. A. H. McConey, 3d Artillery, A. A. Q. M.	do	75 00	.....	75 00	.....
Ajax	do	.....	Feb. 6, 1872	Feb. 6, 1872	Feb. 6, 1872	do	Lt. C. A. H. McConey, 3d Artillery, A. A. Q. M.	do	75 00	.....	75 00	.....
San Antonio	do	.....	Apr. 2, 1872	Apr. 2, 1872	Apr. 2, 1872	do	Lt. C. A. H. McConey, 3d Artillery, A. A. Q. M.	do	75 00	.....	75 00	.....
Do.	do	.....	Feb. 23, 1872	Feb. 23, 1872	Feb. 23, 1872	do	Lt. C. A. H. McConey, 3d Artillery, A. A. Q. M.	do	75 00	.....	75 00	.....
Herald	Schooner	.....	Aug. 7, 1871	Aug. 7, 1871	Apr. 30, 1872	Charleston, S. C.	Lt. C. A. H. McConey, 3d Artillery, A. A. Q. M.	\$350 a voyage	350 00	.....	350 00	.....
Macomaw	Steamer	.....	Dec. 28, 1871	Dec. 28, 1871	June 27, 1872	Fort Johnston, N. C.	Lt. C. A. H. McConey, 3d Artillery, A. A. Q. M.	12 cents per 100 pounds.	43 33	\$8 81	51 13	.....
Kate	Schooner	.....	Feb. 5, 1872	Feb. 5, 1872	Feb. 5, 1872	do	Lt. C. A. H. McConey, 3d Artillery, A. A. Q. M.	12 cents per 100 pounds.	27 86	11 31	39 17	.....
Flash	Sloop	.....	Mar. 1, 1872	Mar. 1, 1872	May 18, 1873	do	Lt. C. A. H. McConey, 3d Artillery, A. A. Q. M.	12 cents per 100 pounds.	4 42	.....	4 42	.....
Oldham	Tug	.....	Oct. 1, 1871	Oct. 1, 1871	Oct. 1, 1871	Fort Mason, N. C.	Lt. A. P. Greene, 4th Artillery, A. A. Q. M.	12 cents per 100 pounds.	9 57	.....	9 57	.....
Not named	Flat-boat	.....	Oct. 12, 1871	Oct. 12, 1871	June 23, 1873	do	Lt. A. P. Greene, 4th Artillery, A. A. Q. M.	For the trip	17 35	.....	17 35	.....
Do.	Sail-boat.	.....	.....	.....	.....	do	do	do	38 75	.....	38 75	.....
Total	.....	.....	.....	.....	.....	.....	.....	.....	30,734 18	30 12	314 30	3,199 73

* \$30 for extra trips and \$60 per hour for over-time.

† In coin.

Correct:

‡ \$3 per ton for stores.

M. I. LUDINGTON, Quartermaster, United States Army.

F.—Statement of vessels owned or purchased by the Government and employed in the Quartermaster's Department during the fiscal year ended June 30, 1872.

Name.	Class.	Tonnage.	When purchased or built, &c.	Estimated value, or cost.	By whom employed.	Where employed.	Amount paid for repairs, &c.	Remarks.
General McPherson.....	Propeller.....	104.92	Sept. 1, 1867.....	\$40,000.....	Capt. G. C. Smith, A. Q. M.....	San Francisco, Cal.....	\$27,411 17.....	Coin, including cost of new boilers and repairs to machinery, &c.
Fulaski.....	Steam launch.....	.....	Mar. 1, 1872.....	7,000.....	Lt. Chas. Saltnur, A. A. Q. M.....	Fort Pulaski, Ga.....	548 00.....	
Margaret.....	Boat.....	32.....	Feb. 9, 1864.....	9,700.....	Maj. E. Saltnur, Q. M.....	Portland, Ore.....	2 193 84.....	
Macchless.....	do.....	176.....	June 5, 1863.....	13,500.....	Capt. W. B. Hughes, A. Q. M.....	Key West, Fla.....	5,000 00.....	
Shoo Fly.....	Sail boat.....	3.....	.....	240.....	Lt. A. P. Greene, A. A. Q. M.....	Fort Macon, N. C.....	100 00.....	
Total.....							35,939 01.....	

Correct:

M. I. LUDINGTON, Quartermaster, U. S. A.

G.—Statement of all troops and stores transported under the direction of the Quartermaster's Department during the fiscal year ending June 30, 1872.

Kind of transportation.	PASSENGERS.			ANIMALS.			STORES.						
	Officers.	Men.	Total.	Horses.	Mules.	Cattle.	Total.	Commissary stores.	Quartermaster stores.	Ordnance stores.	Medical stores.	Miscellaneous.	Total No. of pounds.
NOT OWNED OR RUN BY GOVERNMENT.													
Railroads.....	978	93,599	94,567	3,176	490		3,636	Pounds. 17,713,559	Pounds. 95,471,798	Pounds. 9,740,709	Pounds. 996,074	Pounds. 5,998,114	52,850,925
Steamboats, barges, &c.....	557	14,885	15,392	538	53	30	321	16,408,516	11,866,795	6,353,650	1,379,277	3,349,686	39,347,924
Stages.....	283	944	1,227							459			
Wagons.....	129	1,049	1,164					13,212,368	11,065,219	1,113,776	819,804	1,450,733	27,661,863
Total.....	1,940	40,410	42,350	3,487	684	30	3,957	47,424,436	48,443,793	10,088,594	3,195,135	10,798,533	119,880,511
OWNED OR RUN BY GOVERNMENT.													
Railroads.....	2,161	9,557	11,718	8	15	31	54	1,456,564	603,350	191,352	35,892	916,063	3,203,190
Steamboats, barges, &c.....	2,161	9,557	11,718	8	15	31	54	1,456,564	603,350	191,352	35,892	916,063	3,203,190
Total.....													
Grand total	4,101	49,967	54,068	3,495	699	61	4,011	48,881,000	49,047,123	10,279,946	3,231,017	11,644,615	123,083,701

Respectfully submitted:

M. I. LUDINGTON, Quartermaster, United States Army.

H.—Statement of amounts paid on account of rail, river, stage, and wagon transportation by the Quartermaster's Department during the fiscal year ended June 30, 1872.

Kind of transportation.	Passengers.	Freight.	Expenditures.	Grand totals.
Railroad	\$203,624 34	\$307,808 36	\$166 38	\$411,599 08
Steamboat, barges, &c	238,806 93	331,676 71	55,889 88	625,373 52
Stages	45,006 96	922 61	505 12	46,434 69
Wagons	729 87	1,045,193 69	4,857 20	1,050,780 76
Total	488,168 10	1,585,601 37	61,418 58	2,135,188 05

Respectfully submitted.

M. I. LUDINGTON,
Quartermaster, United States Army.

I.—Statement of accounts and claims in the transportation division, Quartermaster-General's office, for the fiscal year ended June 30, 1872.

	Number.	Value.
Number of accounts and claims on hand July 1, 1871	233	\$1,822,793 20
Number of accounts received during the fiscal year	342	744,316 22
Number of claims received during the fiscal year	639	903,121 53
Total number of accounts and claims on hand and received	1,214	3,470,230 95
Number of accounts referred for settlement during the fiscal year	325	603,171 26
Number of claims referred for settlement during the fiscal year	538	471,998 87
Number of claims transferred to other branches	14	4,377 12
Number of claims rejected during the fiscal year	170	1,911,722 36
Number of claims suspended at the close of fiscal year	11	1,316 89
Total number of accounts and claims referred, rejected and suspended	1,058	3,192,596 50
Number of accounts awaiting action July 1, 1872	92	2,587 43
Number of claims awaiting action July 1, 1872	134	275,057 02
Total number and amount	156	277,644 45

Respectfully submitted.

M. I. LUDINGTON,
Quartermaster, U. S. A.

NOTE.—During the fiscal year ended June 30, 1872, the following claims of the East Tennessee and Virginia, and East Tennessee and Georgia Railroad Companies, (representing large amounts,) were rejected by this office, viz: East Tennessee and Virginia Railroad Company, \$751,200.07; East Tennessee and Georgia Railroad Company, \$765,912.33. Five claims, of large amounts, for use and value of steamers, were also rejected during the fiscal year, stated collectively at \$192,684.61.

K.—Statement of claims under the act of July 4, 1864, chapter 240, in the Quartermaster-General's Office for the fiscal year ended June 30, 1872.

	No.	Amount.	No.	Amount.
On hand July 1, 1871, which had previously been suspended or had received no decisive action.	10,166	\$6,547,130 80	.....	.....
Received during the year	1,124	1,483,314 18	.....	.....
Total number on hand and received .....	.....	.....	11,290	\$8,030,444 98
Decisive action taken during the year:				
Approved	665	367,102 72	.....	.....
Reductions on claims approved .....	.....	410,234 95	.....	.....
Claims rejected	274	396,100 75	.....	.....
Total upon which final action has been taken .....	.....	.....	939	1,173,438 42
Remaining on hand June 30, 1872 .....	.....	.....	10,351	6,857,006 56

Respectfully submitted.

M. I. LUDINGTON,
Quartermaster, United States Army.

L.—Statement of miscellaneous claims in the Quartermaster-General's Office for the fiscal year ended June 30, 1872.

	No.	Amount.	No.	Amount.
On hand July 1, 1871, which had previously been suspended or had received no decisive action.	14, 585	\$7, 457, 183 82	.....	.....
Received during the year	2, 558	748, 658 62	.....	.....
Total number on hand and received			17, 143	\$8, 205, 842 44
Decisive action taken during the year:				
Approved	2, 346	506, 350 71	.....	.....
Reductions on claims approved		32, 031 51	.....	.....
Claims rejected	312	102, 668 29	.....	.....
Total upon which final action has been taken			2, 658	647, 050 51
Remaining on hand June 30, 1872			14, 485	7, 558, 791 93

Respectfully submitted.

M. I. LUDINGTON,
Quartermaster, United States Army.

[GENERAL ORDERS No. 64.]

WAR DEPARTMENT,
Adjutant-General's Office, October 25, 1871.

The following regulations in regard to rendering property-returns and the settlement of property-accounts are published for the information and guidance of all concerned :

I. The following-named reports, heretofore required of officers doing duty in the Quartermaster's Department, will be discontinued after November 1, 1871 :

FORM 4.—Report of stores received for transportation and distribution.

FORM 5.—Monthly return of public animals, wagons, harness, &c.

FORM 6.—Monthly report of forage issued.

FORM 8.—Report of persons hired and employed in the Quartermaster's Department who have deceased, deserted, or been discharged, with pay due.

II. The following-named reports and other papers will, after November 1, be made and disposed of as indicated by the notes on the accompanying forms :

FORM 1.—Report of persons and articles employed and hired, (to include the information heretofore contained in report Form No. 8.)

FORM 2.—List of persons and articles employed and hired and transferred, (heretofore known as Form No. 53.)

FORM 3.—Roll of enlisted men employed on extra duty.

FORM 4.—Consolidated report of all Government troops and stores transported.

FORM 5.—Invoice of stores turned over for transportation.

FORM 6.—Receipt for stores turned over for transportation.

Copies of these forms are appended.

III. The quarterly return of quartermaster's stores (Form 27, heretofore known as Form 23) will hereafter be made, according to the accompanying form, in duplicate only ; one copy, with abstracts and vouchers

complete, to be forwarded to the Quartermaster-General within twenty days after the expiration of the quarter to which it pertains; the other copy to be permanently retained by the officer for his protection.

IV. As soon as possible after its receipt by the Quartermaster-General, the return will be examined in his office, and suspensions or disallowances will not be made on account of slight informalities which do not affect the validity of a voucher, but the officer's attention will be directed to them by suitable advisory remarks.

V. The examination having been completed, the officer making the return will be notified of all errors and irregularities found therein, and granted three months, if stationed east of the Rocky Mountains, or six months, if serving west thereof, to correct them. If the necessary corrections in the return be not made within the prescribed time, the proper commanding officer shall be requested by the Quartermaster-General to appoint a board of survey to ascertain the value of any articles for which the officer fails to account, and as soon as the valuations are received by the Quartermaster-General, the Paymaster-General will be requested to stop their amount from the pay of the delinquent officer, and the Paymaster-General will notify the Quartermaster-General of the stoppage, which notice will be filed with the officer's return. (See Form A, hereto attached, letter requesting the detail of a board of survey.)

VI. As soon as the return shall have been fully corrected, it shall be forwarded to the Third Auditor of the Treasury for settlement, under the direction of the Secretary of War, accompanied by a report of errors, and the manner in which they have been removed, including a statement of the ascertained money value of the deficient articles of property.

VII. Upon receipt of the return by the Auditor, it will be examined so far as to ascertain if the quantities of public property and stores on hand at the date of the last return are correctly restated in the present return, and a report of any errors in such restatement will be promptly transmitted to the Quartermaster-General, who will take such measures for their correction as herein prescribed for errors in other portions of the return.

VIII. The Third Auditor, reviewing the remarks and the action of the Quartermaster-General upon the errors and irregularities contained in the return, will submit any portion thereof that he may deem necessary, with his own views, to the Secretary of War.

IX. Whenever the errors have been corrected, or compensation therefor made as provided, and the action of the Quartermaster-General concurred in by the Auditor, or sustained or modified by the Secretary of War, the return will be regarded as settled, and the Auditor will so certify to the Quartermaster-General, for the information of himself and of the officer concerned.

X. The return, abstracts, vouchers, and supplementary papers will remain in the custody of the Third Auditor, subject at all times to their temporary recall by the Quartermaster-General, or to the inspection of any person duly authorized by that officer or by the Secretary of War.

XI. The return of provisions (Form 1) and return of commissary property, (Form 8,) Subsistence Department, will be made and forwarded to the office of the Commissary-General of Subsistence as heretofore, where a similar course of examination and action shall be taken upon them as is prescribed in these regulations, (II to X.)

XII. The returns of engineer-property will be made, in duplicate, on the forms now used for this purpose, and forwarded to the Chief of

Engineers for his action, who will, after examination, transmit them as provided for in these regulations.

By order of the Secretary of War:

E. D. TOWNSEND,
Adjutant-General.

A.

WAR DEPARTMENT,
QUARTERMASTER-GENERAL'S OFFICE,
Washington, D. C., ———, 187—.

To the commanding officer Fort McHenry, Maryland:

SIR: I have the honor to request that a board of survey be by you convened to ascertain the value of the following-named articles, for which Lieutenant A ——— B ———, —th Infantry, failed to account on his return of quartermaster stores for the — quarter, 187—, while post quartermaster at Fort ———, A. C.: (*here insert a list of the articles.*) Lieutenant B ——— was notified of these errors, (*here insert the date of such notice.*) but up to this date no correction or satisfactory explanation has been received.

Please forward the report of the board to this office as soon as practicable.

Very respectfully, sir, your obedient servant,

Quartermaster General, *United States Army.*

FORM NO. 1.

*Report of persons and articles hired for the month of —, 18—, by —, quarter-
master —, United States Army, at —.*

[To be in duplicate; one copy to be retained, one to be forwarded directed to the Quartermaster-General within ten days after the end of the month. When any increase of the number of persons employed occurs, a copy of the authority therefor to accompany the report.]

15 W

REPORT OF THE SECRETARY OF WAR.

FORM NO. 3.

Roll of non-commissioned officers and privates employed on extra duty as mechanics and laborers, —, during the month of —, 18—, by —
 ————quartermaster —, United States Army.

Names.	Rank or designation.	Company.	Regiment.	By whose order employed.	In what capacity employed.	Term of service.			Per diem-am't of pay.		How employed. Remarks.		
						From—	To—	No. of days.	Cts.	Dolls.		Cts.	
1	Jacob Allen ...	Corporal	B.	20th Infantry.	Colonel George Young.	Overseer ...	1	15	15	35	5	25	In charge of over 20 men.
2	James Jordan .	Private..	B.	20th Infantry.	Colonel George Young.	Artificer....	1	15	15	35	5	25	Carpenter at post.
3	William Jones.	Private..	B.	20th Infantry.	Colonel George Young.	Artificer....	1	15	15	35	5	25	Blacksmith at post.
4	George Gray ...	Private..	B.	20th Infantry.	Colonel George Young.	Laborer	1	15	15	20	3	00	General work at post.
Total amount												18	75

I certify that the above is a correct roll of non-commissioned officers, musicians, and privates employed on extra duty, under my direction, during the month of —, 18—, and that the remarks opposite their names are correct and just.

Examined:
 C——D——, Commanding.
 (Signed in duplicate.)
 A——B——, Quartermaster.

FORM NO. 4.

*Consolidated report of transportation at ———, during the ——— quarter, 18 ——— by ———
———, quartermaster.*

[To be made by each quartermaster who may furnish transportation, and forwarded, to the Quartermaster-General within twenty days after the end of the quarter.]

FORM NO. 5.

*Invoice of stores transferred to — on the — day of —, 18 , for transportation
to —, at —.*

[To be in duplicate; both copies to be signed by the officer who turns over the stores, and to be handed to the quartermaster who receives them for transportation.]

FORM NO. 6.

Receipt for stores transferred to ——— quartermaster ——— at ——— for transportation to ——— at ——— on the ——— day of ——— 18—.

[To be in duplicate, both copies to be signed by the officer who receives the stores for transportation, and to be handed to the officer who has turned them over to him.]

FORM NO. 27.

— — — —, quartermaster :

*Quarterly returns of quartermaster's stores received and issued in the quarter ending on the
— day of —, 18—.*

[To be made in duplicate; one copy to be forwarded to the Quartermaster-General within 20 days after the expiration of the quarter, the other to be retained by the officer.]

FORM NO. 27.

NOTE.—To be made in duplicate; one to be retained by the officer, one to be sent to the Quartermaster-General's Office.

Quarterly return of quartermaster's stores received, issued, and remaining on hand at ———, in the quarter ending on the ——— of ———, 18—, by ———, quartermaster.

NOTE.—In order to secure uniformity in returns of quartermaster's stores, they should be itemized and classed under the following heads:

1. Fuel.
2. Forage.
3. Straw.
4. Stationery.
5. Office and barrack furniture.
6. Means of transportation.
7. Veterinary tools.
8. Blacksmiths' tools.
9. Farriers' tools.
10. Carpenters' tools.
11. Wheelwrights' tools.
12. Masons' and bricklayers' tools.
13. Saddlers' tools.
14. Miscellaneous tools.
15. Machinery.
16. Miscellaneous stores for expenditure, alphabetically arranged, as building materials, bricks, horse-medicines, horseshoes, lumber, rope, steel, &c., &c.

Quarterly return of quartermaster's stores, &c.—Continued.

Classes		4. STATIONERY.																					
		Ozs.	No.	Cross.	No.	Lead-pencils.	Pcs.	No.	Inkstands.	No.	Water-stamps.	No.	Knives.	No.	Paper-folders.	No.	Mucilage, bottles of.	No.	Rubber, pieces of.	No.	Rulers.	No.	
Abstracts, &c.	Per last return. On hand.																						
	Abstract D.... Received by purchase.																						
	Abstract E.... Received from officers.																						
	Abstract F.... Fabricated, taken up, &c.																						
	Total to be accounted for.																						
	Per Abstract G. Fuel, forage, and straw.																						
	Per Abstract H. Stationery.																						
	Per Abstract I. Expended, sold, &c.																						
	Per Abstract K. Issued and transferred.																						
	Total issued and expended.																						
	Total remaining on hand.																						
	Condition—1. In good order.																						
	2. Unfit for service, but repairable.																						
	3. Totally unfit for service.																						

[Here insert any extra leaves that may be required by the number of articles borne on the return.]

I certify, on honor, that the foregoing return exhibits a true and correct statement of all the property which has come into my hands, on account of the Quartermaster's Department, during the quarter ending on the — of —, 18—.

FORM NO. 28.

ABSTRACT D.

Abstract of articles purchased during the ——— quarter, 18—, by ——— ———, quartermaster, United States Army, at ———.

.....

[To be in duplicate; one copy to be retained, one to be sent with quarterly return of property to the Quartermaster-General within twenty days after the expiration of the quarter.

This abstract appertains exclusively to the property return, and is designed to show all the supplies purchased by the quartermaster, whether paid for or not. No vouchers of the purchases paid for accompany this abstract. They are in Monthly Abstract A. Purchases not paid for are vouched as in Form No. 29.]

16 W

Form No. 28.

Abstract of articles purchased at — during —, 18—, by —.

Classes.			Fuel.												Forage.	Straw.	Stationery.	
Date.	No. voucher.	From whom purchased.	Amount.		Hard wood.			Soft wood.			Kindling-wood.			Anthra-cite coal.	Bitu-minous coal.			
			Dolla.	Cts.	Cords.	Feet.	Inches.	Cords.	Feet.	Inches.	Cords.	Feet.	Inches.						Lbs.	Lbs.
		Articles pur-chased and paid for....																
		Articles pur-chased and not paid for.																
		Total pur-chased dur-ing the month.....																

I certify that the above abstract is correct.

(Signed in duplicate.)

_____,
Quartermaster.

FORM NO. 29.

No. —, *Abstract D*, — quarter, 18—, — Dollars, — 100.

Property purchased and not paid for by end of quarter.

[To be in duplicate; one copy to be retained by the officer, one to be forwarded with *Abstract D*, within 20 days after the end of the quarter, to the Quartermaster-General.]

FORM No. 29.—(Voucher to Abstract D.)

THE UNITED STATES,

To ———, Dr.

Place and date of purchase.		Dolls.	Cts.

I CERTIFY, on honor, that the above account is correct and just; that I purchased the articles above enumerated of the said ——— at the prices therein charged, amounting to ——— and ——— cents, and that I have not paid the account.

(Signed in duplicate.)

_____,
Quartermaster.

FORM NO. 30.

ABSTRACT E.

*Articles received from officers during the ——— quarter, 18—, by ———, quartermaster,
——— United States Army, at ———.*

[To be in duplicate; one copy to be retained by the officer, one to be sent to the Quartermaster-General with the Quarterly Return.

All property received from other officers will be entered on this abstract, whether receipted for or not. It will be supported by vouchers No. 31.]

FORM NO. 31.

Voucher No. —, Abstract E, — quarter, 18—.

*Invoice of stores transferred by —, quartermaster —, United States Army,
at —, to —, quartermaster —, United States Army, at —.*

[To be made in duplicate; both to be forwarded or delivered to the officer to whom the articles are transferred. He will retain one and forward the other, with his Abstract E, to the Quartermaster-General.]

NOTE.—When no invoice is received the receiving officer will substitute for this form of voucher a list of the stores received, certified by himself. When the person responsible for the property entered without invoice is known it will be entered in his name.]

FORM NO. 31.—(Voucher to Abstract E.)

Invoice of quartermaster's stores, &c., transferred by _____, quartermaster _____, United States Army, at _____, to _____, quartermaster _____, United States Army, at _____, on the _____ day of _____, 18____.

Number or quantity.		Articles.	Cost when new.			Condition when delivered.	Remarks.
			Dolla.	Cts.	Per.		
<i>In figures.</i>	<i>In words.</i>						
40	Forty	Felling-axes	1	00	Each	New	
300	Three hundred pounds	Bar-iron, assorted		06	Pound	New	
10	Ten	Wheelbarrows	4	00	Each	Worn	
5	Five	Wagons, (4-horse)	150	00	Each	Worn	
5	Five	Wagons, (4-horse)	150	00	Each	New	
20,000	Twenty thousand pounds	Corn	1	00	Bushel	Good	

I certify that I have this day transferred to _____, quartermaster _____, United States Army, at _____, the articles specified in the foregoing list.

(Signed in duplicate.)

Quartermaster.

FORM NO. 32.

ABSTRACT F.

Articles received from various sources during the ——— quarter, 18—, ———, quar-
termaster ———, United States Army, at ———.

[To be made in duplicate; one copy to be retained by the officer, one forwarded to the Quartermaster-General with the quarterly return.]

FORM No. 32.—(Abstract F.)

Abstract of articles received from various sources during the quarter ending on the — day of —, 18—, by —, quartermaster —, United States Army.

CLASSES																					
Date. 18—.	No. of voucher.	From whence received.																			
		Found at the post																			
		Manufactured																			
		Parts of articles broken up																			
		Heretofore issued, but not consumed																			
		Captured from the enemy																			
		Total																			

I certify that the above abstract is correct.

(Signed in duplicate.)

....., Quartermaster.

NOTE.—This abstract contains all quartermaster's property found at the post not borne on the previous return; all that may come to the quartermaster's possession without his knowledge, who may be accountable for it; articles manufactured in the quarter; material or parts of articles that have been condemned or broken up; fuel and forage issued, but not consumed, &c. Separate lists of each class, with the necessary explanation, will be filed with the abstract.

FORM NO. 33.

ABSTRACT G.

Fuel, forage, and straw issued during the ——— quarter, 18—, by ——— ———, quartermaster ———, at ———.

[To be in duplicate; one copy to be retained, one to be sent with quarterly return to the Quartermaster-General. All fuel, forage, and straw issued is entered on this abstract; that transferred to other officers, to be accounted for by them, is entered on Abstract K.

For vouchers, see Forms 34 and 35.]

FORM NO. 34.

Voucher No. —, Abstract G, — quarter, 18—.

Requisition for fuel, forage, and straw, required by ——. Issued —, 18—.

[To be in duplicate; one copy retained by issuing officer, one sent to the Quartermaster-General with Abstract G.

This form of requisition is used for a regiment, company, detachment, and single officer of whatsoever rank.]

FORM NO. 35.

Voucher No. —, Abstract G, — quarter, 18—.

Forage and straw issued to public animals by —, quartermaster —, United States Army, at —, in the month of —, 18—.

[To be in duplicate; one copy to be retained by the officer, one sent with the quarterly abstract G to the Quartermaster-General.

This form is used to account for the forage consumed by the public animals under charge of the officer who issues the forage.]

FORM NO. 36.

ABSTRACT H.

*Abstract of stationery issued during the ——— quarter, 18—, ———, quartermaster
———, United States Army, at ———.*

[To be in duplicate; one copy to be retained by the officer, one sent with the quarterly return to the Quartermaster-General.

The stationery used by the quartermaster in the public service is entered on this abstract, as are all issued by him.

The voucher to this abstract is Form 37.

Transfers are entered on Abstract K.]

FORM NO. 37.

Voucher No. —, Abstract H. — quarter, 18—.

Requisition for stationery for — —, at —.

[To be in duplicate; one copy retained by officer, one sent to Quartermaster-General with Quarterly Abstract H.]

FORM NO. 38.

Abstract I. ——— quarter, 18—.

Articles expended, lost, destroyed and sold.

———, quartermaster ———, United States Army, at ———.

[To be in duplicate; one copy retained by the officer, one sent with the quarterly return to the Quartermaster-General. The vouchers to this abstract are Forms 39, 40, 41. Stationery expended by the quartermaster for public service in his own office should not be entered on this abstract; it should be entered and accounted for on Abstract H.]

FORM NO. 39.

Voucher No. —, Abstract I, — quarter, 18—.

*Monthly list of stores expended, — — —, quartermaster — — —, United States Army,
at — — —, in the month of — — —, 18—.*

[To be in duplicate; one copy to be retained by the officer, one to be sent to the Quartermaster-General with the Quarterly Abstract I.

NOTE.—This list should be made out monthly, to enable the quartermaster to know the exact state of his supplies. The abstract, when forwarded, will be accompanied by all the monthly lists.]

FORM NO. 38.

Abstract of articles expended, lost, destroyed in the public service, sold, &c., at _____, under the direction of _____, in the quarter ending on the _____ of _____, 18__.

Classes.....													
By whom made.													
Voucher.													

Quartermaster

ter, 18—.

—, 18—.

to officer, one to be sent to the
able the quartermaster to know
forwarded, will be accompanied

Monthly and to the
[To be in the
Quartermaster
Norm.—The
the exact state
by all the sentinels]

FORM NO. 39.—(Voucher to Abstract I.)

List of quartermaster's stores in the public service at _____, under the direction of _____
 _____, quartermaster _____, United States Army, in the month of _____, 18—.

Number or quantity.	Articles.	Application.

I certify, on honor, that the several articles of quartermaster's stores above enumerated have been necessarily expended in the public service at this station, as indicated by the marginal remarks annexed to them, respectively.

_____,
 Quartermaster.

Approved : _____,
 Commanding.

(Signed in duplicate.)

FORM NO. 40.

Voucher No. —, Abstract I, — quarter, 18—.

Articles lost or destroyed in the month of —, 18—.

[To be in duplicate; one copy to be retained by the officer, one to be sent to the Quartermaster-General with the Quarterly Abstract I.

NOTE.—This list should be made out monthly, to enable the quartermaster to know the exact state of his supplies. The abstract, when forwarded, will be accompanied by all the monthly lists.]

FORM NO. 40.—(Voucher to Abstract I.)

List of articles lost or destroyed in the public service at — while in possession and charge of —, quartermaster —, United States Army, in the month of —, 18—.

Number or quantity.	Articles.	Circumstances and cause.

I certify that the several articles of quartermaster's stores above enumerated have been unavoidably lost or destroyed while in the public service, as indicated by the remarks annexed to them, respectively.

Approved: _____

_____,
Commanding.

_____,
Quartermaster.

(Signed in duplicate.)

FORM NO. 41.

Voucher No. —, Abstract I, — quarter, 18—.

ACCOUNT OF SALES AT AUCTION.

— dollars — cents, on the — of —, 18—, —, quartermaster
—, United States Army, at —.

[To be in duplicate; one copy retained by officer, one sent by next mail to Quartermaster-General for file with the quarterly return, when received, to which it pertains.

An account in this form should be prepared at every sale of public property. All money received from sales should be immediately deposited in the nearest United States depository to the credit of the Treasurer of the United States; the original certificate of deposit to be forwarded at one to the Quartermaster-General, with one copy of this account of sales, and the duplicate* certificates of deposit filed with the accounts-current.]

* See General Orders No. 65, A. G. O., 1871.

FORM No. 41:—(Voucher to Abstract I.)

Account of sales of articles of public property sold at public auction at ———, under the direction of ——— ———, quartermaster ———, United States Army, on the ——— of ———, 18—.

Number or quantity.	Articles.	Purchaser.	Amount.

I certify that the above account of sales is accurate and just.

Auctioneer.

I certify that the above-enumerated articles were sold at public auction, as above stated, pursuant to _____, and the amount received therefrom, after deducting the expenses of the sale, (the vouchers for which are filed herewith,) has been taken up on my account-current for the month of _____, 18—.

Quartermaster.

(Signed in duplicate.)

FORM NO. 42.

Abstract K, ——— quarter, 18—.

Articles transferred by ——— ———, quartermaster ———, United States Army, at ———.

[To be in duplicate; one copy retained by officer, one sent to Quartermaster-General with quarterly return.

NOTE.—This abstract contains all transfers of stores to other officers, to be accounted for by them; the vouchers will be their receipts. When these are not received in time, the quartermaster will substitute his own certified list of the stores sent and the bill of lading. The receipts he will afterward transmit when he receives them.]

FORM NO. 38.

Abstract I. ——— quarter, 18—.

Articles expended, lost, destroyed and sold.

———, quartermaster ———, United States Army, at ———.

[To be in duplicate; one copy retained by the officer, one sent with the quarterly return to the Quartermaster-General. The vouchers to this abstract are Forms 39, 40, 41. Stationery expended by the quartermaster for public service in his own office should not be entered on this abstract; it should be entered and accounted for on Abstract H.]

FORM NO. 39.

Voucher No. —, Abstract I, — quarter, 18—.

*Monthly list of stores expended, —, —, quartermaster —, United States Army,
at —, in the month of —, 18—.*

[To be in duplicate; one copy to be retained by the officer, one to be sent to the Quartermaster-General with the Quarterly Abstract I.

NOTE.—This list should be made out monthly, to enable the quartermaster to know the exact state of his supplies. The abstract, when forwarded, will be accompanied by all the monthly lists.]

FORM NO. 39.—(Voucher to Abstract I.)

List of quartermaster's stores in the public service at _____, under the direction of _____
 _____, quartermaster _____, United States Army, in the month of _____, 18—.

Number or quantity.	Articles.	Application.

I certify, on honor, that the several articles of quartermaster's stores above enumerated have been necessarily expended in the public service at this station, as indicated by the marginal remarks annexed to them, respectively.

Approved: _____

 Commanding.

 Quartermaster.

(Signed in duplicate.)

FORM No. 40.

Voucher No. —, Abstract I, — quarter, 18—.

Articles lost or destroyed in the month of —, 18—.

[To be in duplicate; one copy to be retained by the officer, one to be sent to the Quartermaster-General with the Quarterly Abstract I.

NOTE.—This list should be made out monthly, to enable the quartermaster to know the exact state of his supplies. The abstract, when forwarded, will be accompanied by all the monthly lists.]

Statement of the price at which clothing for the Army of the United States will be issued from January 1, 1872, until further orders.

Clothing.	Engineer troops.	Hospital stewards.	Ordnance sergeants.	Ordnance mechanics.	Cavalry.	Light artillery.	Artillery.	Infantry.
Uniform hat	\$1 00	\$1 00	\$1 00	\$1 00	\$1 00	\$1 00	\$1 00	\$1 00
feather	7	7	7	7	7	7	7	7
cord and tassel	7	7	7	7	7	7	7	7
eagle	1	1	1	1	1	1	1	1
castle	9							
shell and flame			2	2				
crossed sabers					1			
crossed cannon						1	1	
bugle						1		1
letter					1	1	1	1
number					1	1	1	1
cap, (light artillery)						1 56		
tulip						5		
cord and tassel						44		
plate						3		
rings, pairs of						3		
hair plume						44		
Forage cap	44	44	44	44	44	44	44	44
cover	24	24	24	24	24	24	24	24
Uniform coat, musicians	5 89						5 89	5 89
privates	5 55	5 55	5 55	5 55			5 55	5 55
jacket, musicians					4 56	4 56		
privates					4 11	4 11		
Chevrons, pairs, non-commissioned			38		38		38	38
Chevrons, pairs, first sergeants	18				18	18	18	18
sergeants	12				12	12	12	12
corporals	9				9	9	9	9
Caduceus		43						
Shoulder scales, pairs, non-commissioned staff		44	44		44		44	44
Shoulder scales, pairs, sergeants	40				40	40	40	40
privates	31			31	31	31	31	31
Trousers, sergeants	2 22	2 22	2 22	2 22	2 73	2 73	2 22	2 22
corporals	2 17	2 17	2 17	2 17	2 67	2 67	2 17	2 17
privates	2 10	2 10	2 10	2 10	2 62	2 62	2 10	2 10
Sash	1 16	1 16	1 16	1 16	1 16	1 16	1 16	1 16
Flannel sack coat, (unlined)	1 77	1 77	1 77	1 77	1 77	1 77	1 77	1 77
(lined)	2 13	2 13	2 13	2 13	2 13	2 13	2 13	2 13
shirt	1 00	1 00	1 00	1 00	1 00	1 00	1 00	1 00
Knit shirt	1 00	1 00	1 00	1 00	1 00	1 00	1 00	1 00
Canton flannel drawers	67	67	67	67	67	67	67	67
Knit drawers	67	67	67	67	67	67	67	67
Stockings, per pair	38	38	38	38	38	38	38	38
Bootees, sewed	1 20	1 20	1 20	1 20			1 20	1 20
pegged	1 00	1 00	1 00	1 00			1 00	1 00
Boots, sewed					2 07	2 07		
pegged					1 77	1 77		
Great coats	5 33	5 33	5 33	5 33	6 44	6 44	5 33	5 33
lined with blanket	6 44	6 44	6 44	6 44	6 44	6 44	6 44	6 44
Blankets, woolen	3 11	3 11	3 11	3 11	3 11	3 11	3 11	3 11
rubber	1 96	1 96	1 96	1 96			1 96	1 96
painted	1 18	1 18	1 18	1 18			1 18	1 18
Poncho, rubber					2 63	2 63		
painted					1 33	1 33		
Leather leggings	76	76	76	76			76	76
Linen leggings	44	44	44	44			44	44
Overalls	1 09			1 09				
Stable frocks					83	83		
Mittens, wool, per pair	22	22	22	22	22	22	22	22
Buffalo overshoes, per pair	1 20	1 20	1 20	1 20	1 20	1 20	1 20	1 20
Lace, worsted, 1½-inch, per yard	10	10	10	10	10	10	10	10
¼-inch, per yard	3½	3½	3½	3½	3½	3½	3½	3½

Prices at which camp and garrison equipage will be charged in cases of loss or damage.

ARTICLES.		ARTICLES.	
Iron bunks.....	\$4 75	Wall tent.....	\$33 33
Bed-sack, single.....	1 56	fly.....	12 89
double.....	1 71	poles, sets.....	80
Mosquito-bars.....	89	pins, sets.....	21
Ax.....	73	Wall tent, complete.....	\$47 23
helve.....	9		
sling.....	31	Hospital tent.....	\$77 78
Hatchet.....	36	fly.....	26 67
helve.....	3	poles, sets.....	1 71
sling.....	25	pins, sets.....	49
Spade.....	61	Hospital tent, complete....	106 65
Shovel.....	59		
Pickax.....	67	Common tent.....	\$17 11
helve.....	7	poles, sets.....	51
Camp-kettle.....	44	pins, sets.....	13
Mess-pan.....	20	Common tent, complete....	17 75
Iron pot.....	82		
Garrison-flag.....	72 70	Shelter tent, complete.....	4 35
halyards.....	2 55	Tent pins, hospital, large.....	2
Storm-flag.....	21 67	wall, large.....	1
Recruiting flag.....	4 67	common, small.....	1
halyards.....	13		
Guidon.....	4 44	Regimental book, order... \$1 51	
Camp color.....	79	letter... 1 51	
Standard for mounted regiments..	10 00	index... 87	
National color, artillery and infantry	27 56	descr't'e. 2 11	
Regimental color, artillery and infantry	34 45	gen. ord. 1 56	
Color belt and sling.....	1 57	Regimental books, set.....	7 56
Trumpet, with extra mouth-piece..	1 45		
Bugle, with extra mouth-piece....	1 63	Post book, morning report..	40
Cord and tassel for trumpet or bugle	45	guard report... 75	
Fife, "B" or "C".....	17	order..... 45	
Drum, complete.....	3 45	letter..... 45	
head, batter.....	49	Post books, set.....	2 05
snare.....	19		
sling.....	18	Company book, cloth'g ac't, \$1 33	
sticks, pairs.....	11	descriptive, 71	
carriage.....	23	order..... 55	
cord.....	15	morn'g rep. 1 00	
snares, sets.....	11	Company books, set.....	3 59
case.....	29		
		Record book for target practice...	33

Allowance of clothing.

Articles.	First year.	Second year.	Third year.	Fourth year.	Fifth year.	Total for five years.
Cap, light artillery, with trimmings, complete.....	1	1	1	1	1	5
Plume, red horse-hair.....	1		1			2
Hat, with trimmings, complete.....	1	1	1	1	1	5
Forage cap.....	1	1	1	1	1	5
Cover for forage cap.....	1	1	1	1	1	5
Coat, or jacket.....	2	1	2	1	2	8
Trousers.....	3	2	3	2	3	13
Shirts.....	3	3	3	3	3	15
Drawers.....	3	2	2	2	2	11
*Bootees, pairs of.....	4	4	4	4	4	20
Stockings, pairs of.....	4	4	4	4	4	20
Great coat.....	1					1
Stable-frock, (for mounted men).....	1		1			2
Fatigue overalls, (for engineers and ordnance).....	1	1	1	1	1	5
Blanket, woolen.....	2		1			3
Blanket, water-proof, (for foot-troops).....	1	1	1	1	1	5
Panchos, water-proof, (for mounted troops).....	1	1	1	1	1	5
Flannel sack-coats.....	2	2	2	2	2	10

* Mounted men may receive one pair of boots and two pairs of bootees instead of four pairs of bootees.

Table specifying the money allowance for clothing to enlisted men of the Army of the United States.

	NON-COMMISSIONED STAFF.						FIRST SERGEANT.				SERGEANT.			
	Chief musicians.						Engineers.	Cavalry.	Light artillery.	Artillery and in- fantry.	Engineers.	Cavalry.	Light artillery.	Artillery and in- fantry.
	Cavalry.	Light artill- ery.	Artillery and infantry.	Ordnance ser- geant.	Hospital stew- ard.	Engineers.								
Per month first year.....	\$4 30	\$4 38	\$4 18	\$4 21	\$4 13	\$4 16	\$4 15	\$4 26	\$4 07	\$4 15	\$4 15	\$4 14	\$4 25	\$4 06
Per month second year.....	2 39	2 42	2 42	2 48	2 39	2 47	2 37	2 44	2 38	2 46	2 46	2 36	2 44	2 37
Per month third year.....	3 32	3 43	3 39	3 42	3 34	3 39	3 29	3 40	3 30	3 38	3 38	3 28	3 39	3 29
Per month fourth year.....	2 39	2 46	2 43	2 48	2 39	2 47	2 37	2 44	2 38	2 46	2 46	2 36	2 44	2 37
Per month fifth year.....	2 99	3 05	3 07	3 16	3 08	3 13	2 95	3 03	3 04	3 12	3 12	2 94	3 02	3 03
Total first year.....	50 40	51 72	49 44	50 52	49 56	49 92	49 80	51 12	48 84	49 80	49 80	49 68	51 00	48 72
Total second year.....	28 63	29 52	28 68	29 76	28 68	29 64	28 44	29 28	28 56	29 52	29 52	28 32	29 28	28 44
Total third year.....	39 84	41 16	39 96	41 04	40 08	40 68	39 48	40 80	39 60	40 56	40 56	39 36	40 68	39 48
Total fourth year.....	28 68	29 52	28 68	29 76	28 68	29 64	28 44	29 28	28 56	29 52	29 52	28 32	29 28	28 44
Total fifth year.....	35 88	36 72	36 84	37 92	36 96	37 56	35 40	36 36	36 48	37 44	37 44	35 28	36 34	36 36
Total for five years.....	183 48	188 64	183 60	189 00	183 96	187 44	181 56	186 84	182 04	186 84	186 84	180 96	186 48	181 44
ARTIFICERS AND PRIVATES.														
	CORPORAL.				MUSICIANS.				SERGEANTS AND PRIVATES.					
	Chief musicians.				Engineers.	Cavalry.	Light artillery.	Artillery and infantry.	Engineers.	Cavalry.	Light artillery.	Artillery and infantry.	Engineers.	Cavalry.
	Cavalry.	Light artill- ery.	Artillery and infantry.	Ordnance ser- geant.										
Per month first year.....	\$4 13	\$4 11	\$4 23	\$4 04	\$4 14	\$4 15	\$4 26	\$4 05	\$4 09	\$4 09	\$4 08	\$4 00	\$4 09	\$4 00
Per month second year.....	2 45	2 35	2 42	2 36	2 46	2 37	2 45	2 37	2 43	2 43	2 34	2 41	2 43	2 34
Per month third year.....	3 36	3 37	3 37	3 37	3 28	3 31	3 42	3 29	3 33	3 33	3 23	3 34	3 33	3 24
Per month fourth year.....	2 45	2 35	2 42	2 36	2 46	2 37	2 45	2 37	2 43	2 43	2 34	2 41	2 43	2 34
Per month fifth year.....	3 10	2 92	3 00	3 01	3 13	2 97	3 04	3 04	3 07	3 07	2 90	2 97	3 07	2 96
Total first year.....	49 56	49 30	50 64	48 46	49 68	49 80	51 12	48 60	49 08	49 08	49 96	50 40	49 08	48 00
Total second year.....	29 40	29 20	29 04	28 32	29 52	28 44	29 40	28 44	28 40	28 40	28 08	28 62	28 08	28 00
Total third year.....	40 23	39 24	40 44	39 34	40 56	39 72	41 04	39 48	39 96	39 96	38 76	39 76	38 96	38 96
Total fourth year.....	29 40	29 20	29 04	28 32	29 52	28 44	29 40	28 44	28 40	28 40	28 08	28 62	28 08	28 00
Total fifth year.....	37 90	35 04	36 00	36 12	37 56	35 64	36 48	36 48	36 84	36 84	34 80	35 84	35 64	35 76
Total for five years.....	185 88	180 00	185 16	180 48	186 84	182 04	187 44	181 44	184 20	184 20	178 68	183 96	183 96	178 80

8.—*Pamphlet of drawings of military buildings recommended to the Secretary of War by the Board on Revision of the Army Regulations.*

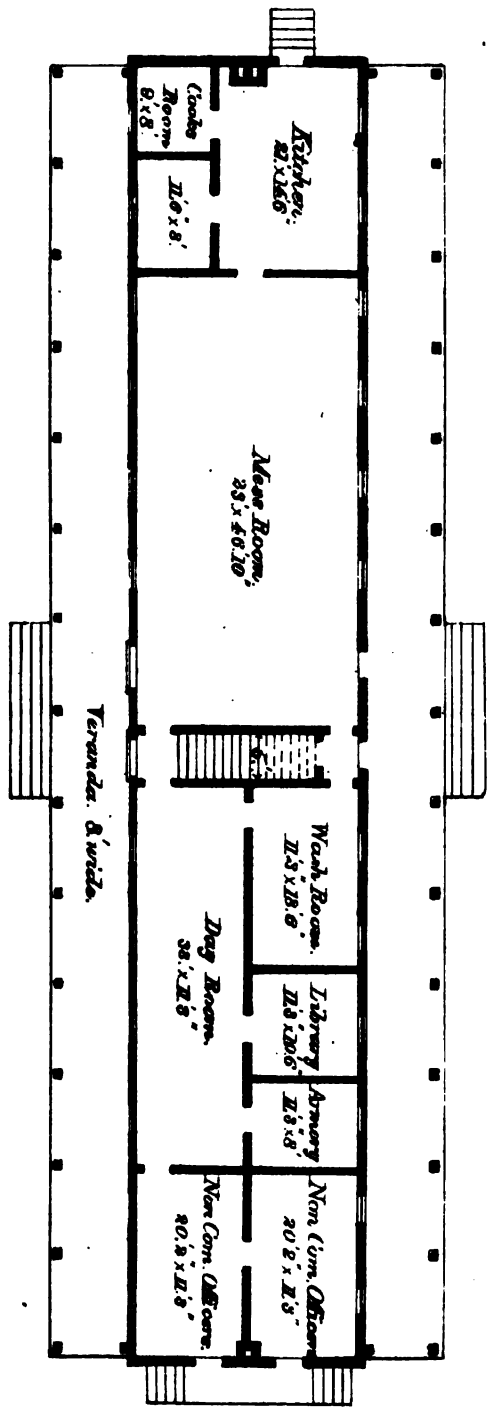
WAR DEPARTMENT,
QUARTERMASTER-GENERAL'S OFFICE,
Washington, D. C., September 14, 1872.

The accompanying drawings of military buildings were recommended to the Secretary of War by the Board on Revision of the Army Regulations.

M. C. MEIGS,
Quartermaster-General, Brevet Major-General, U. S. A.

No. 1.

COMPANY QUARTERS.



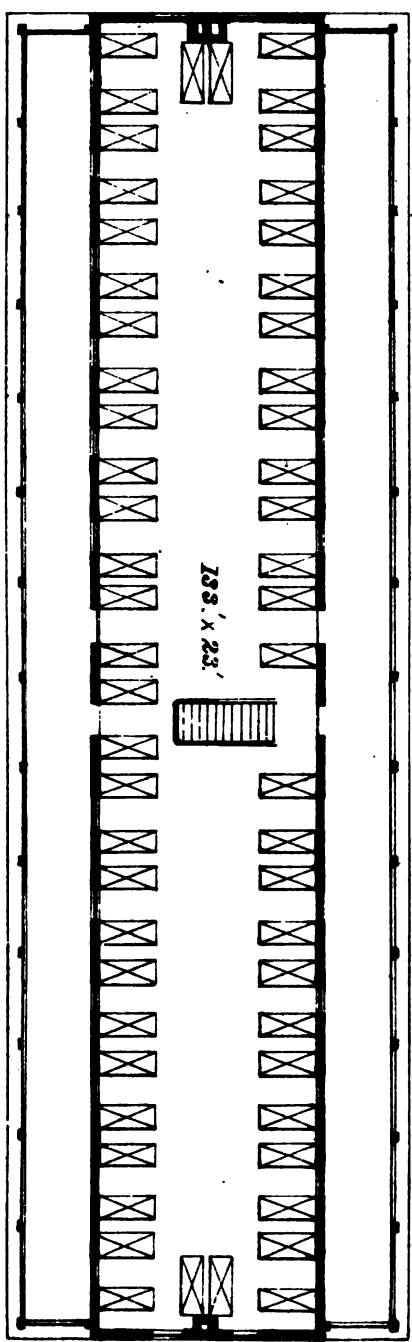
Plan of 1st Story.

Scale 20 feet to inch.



No. 2.

COMPANY QUARTERS.

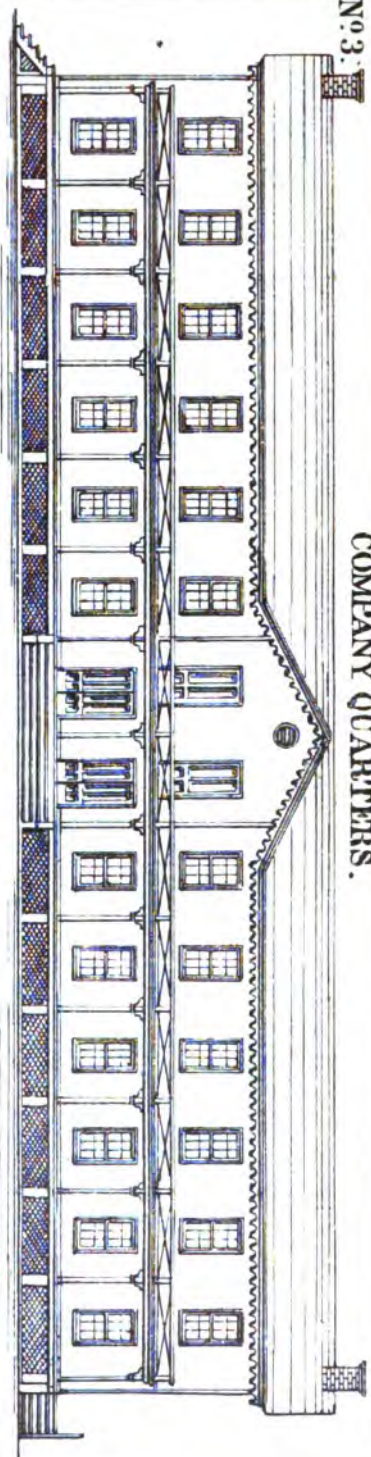


Scale 20 feet to 1 inch.



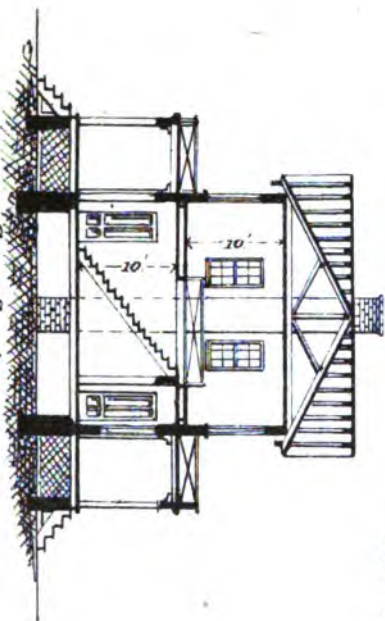
No. 3.

COMPANY QUARTERS.

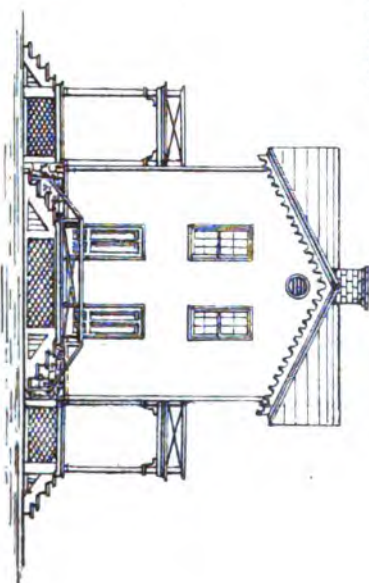


Front Elevation.

Scale: 20 feet to inch.



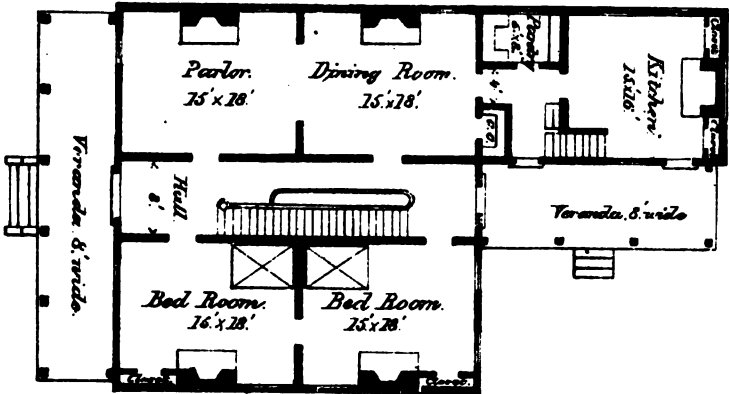
Cross Section



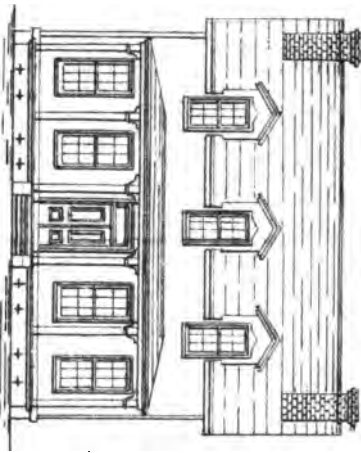
Side Elevation.

No. 4.

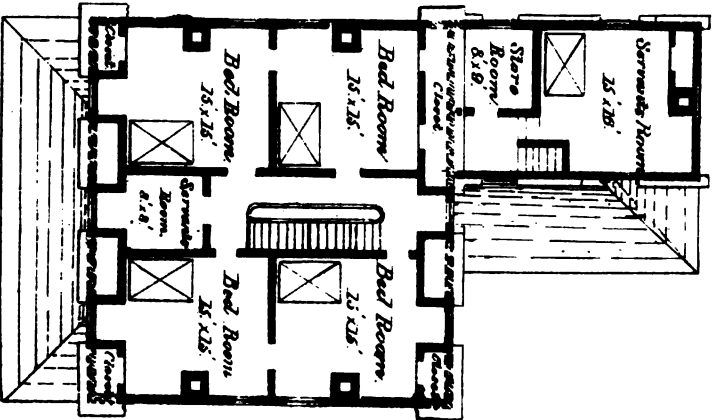
COMMANDING OFFICER'S QRS.



Plan of 1st Story.



Front Elevation.

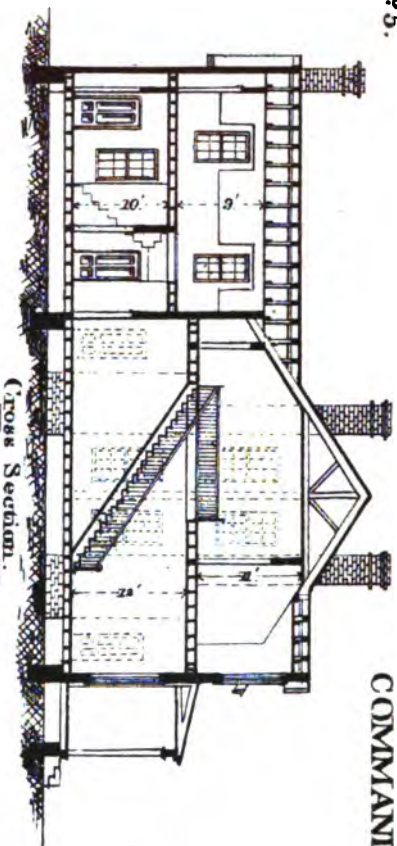


Plan of 2^d Story.

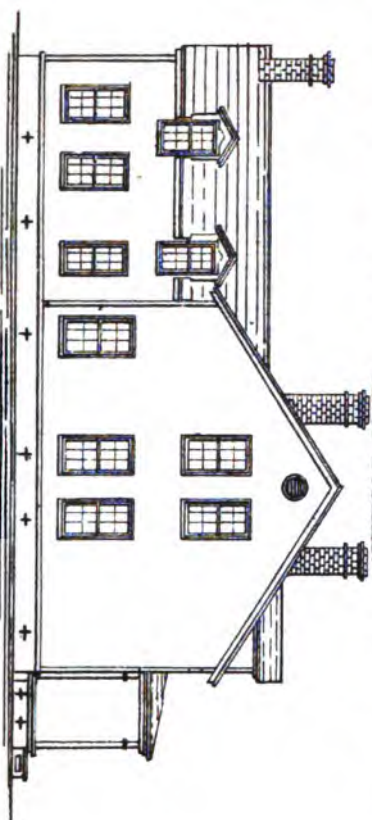
Scale 20 feet to inch.

Nº 5.

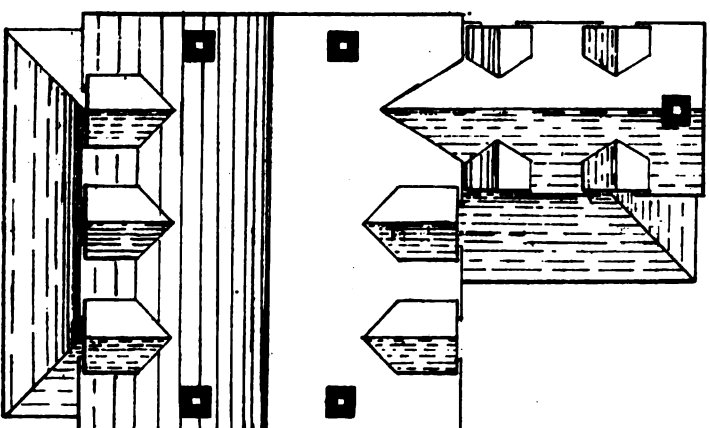
COMMANDING OFFICERS QUARTERS.



(Cross Section.)



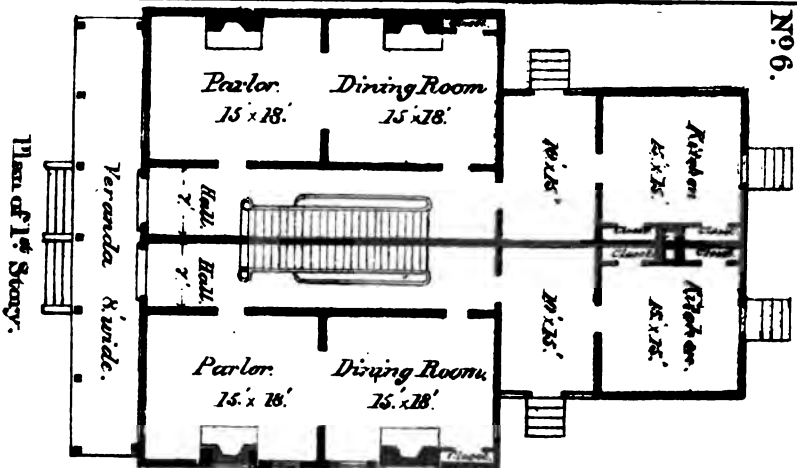
Side Elevation.



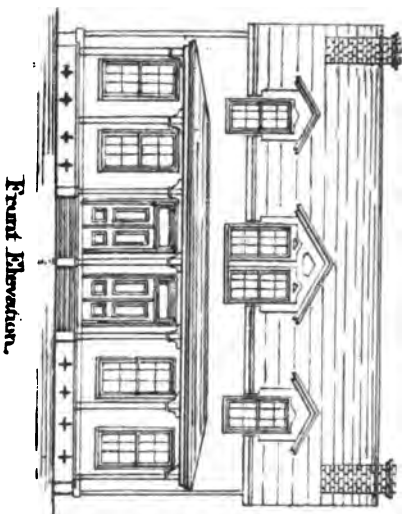
Plan of Roof.

Scale. 20 feet to Inch.

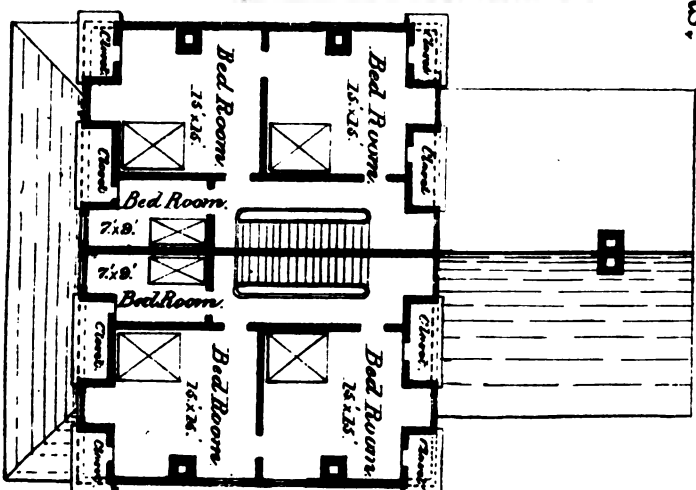
No. 6.



COMPANY OFFICERS' QUARTERS.



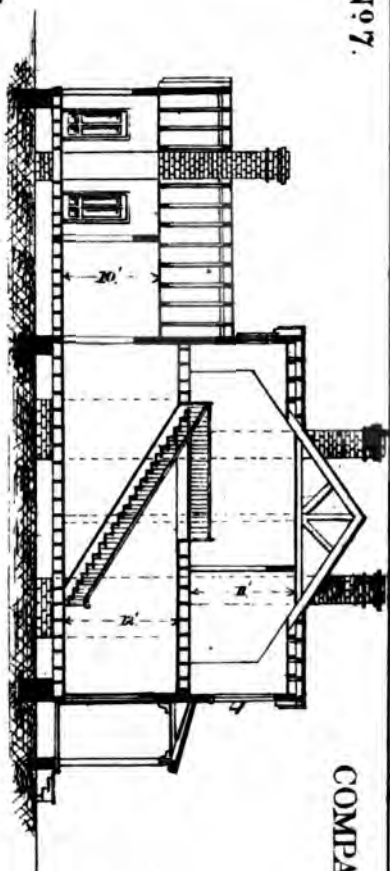
Scale. 30 feet to linech.



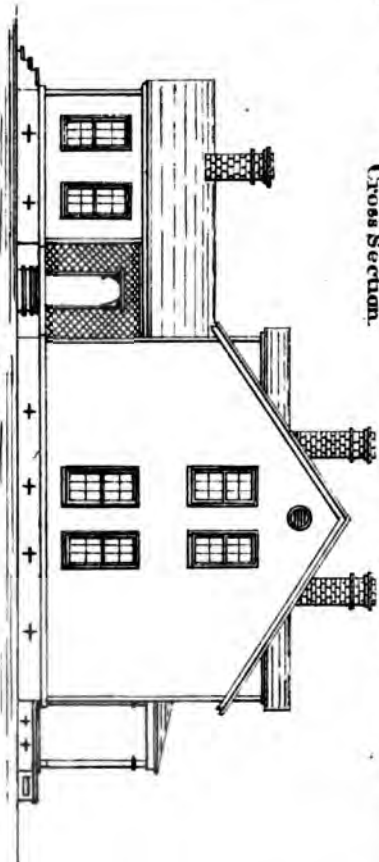
Plan of 2^d Story.

No 7.

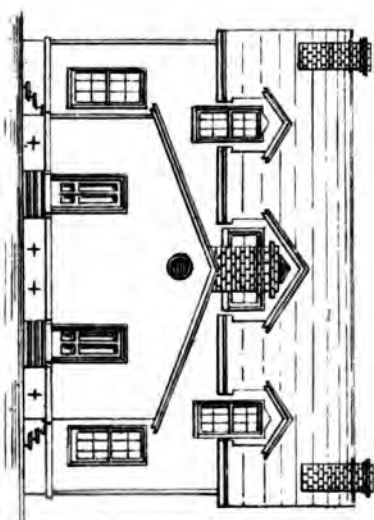
COMPANY OFFICERS' QUARTERS



Cross Section.

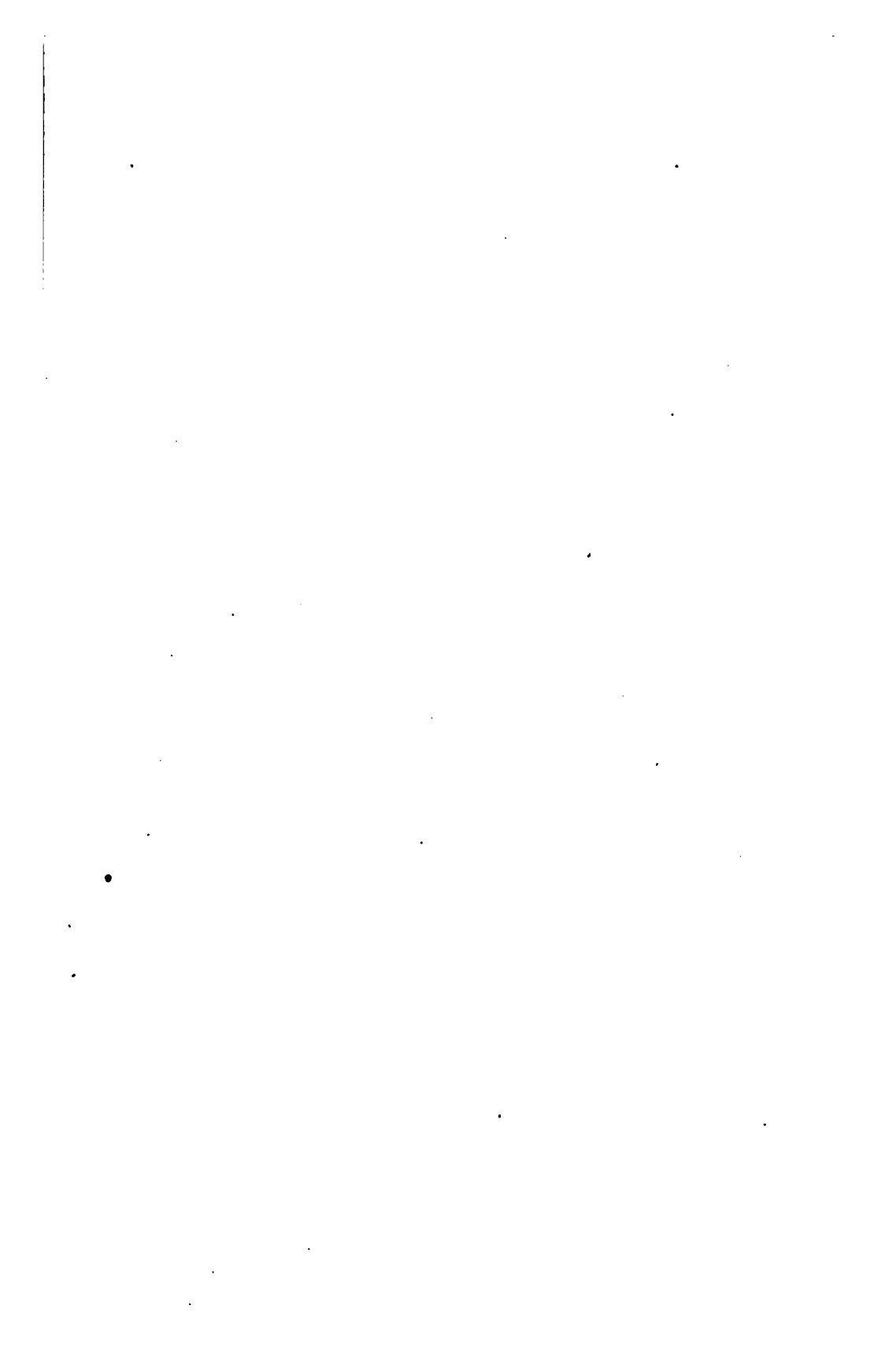


Side Elevation.

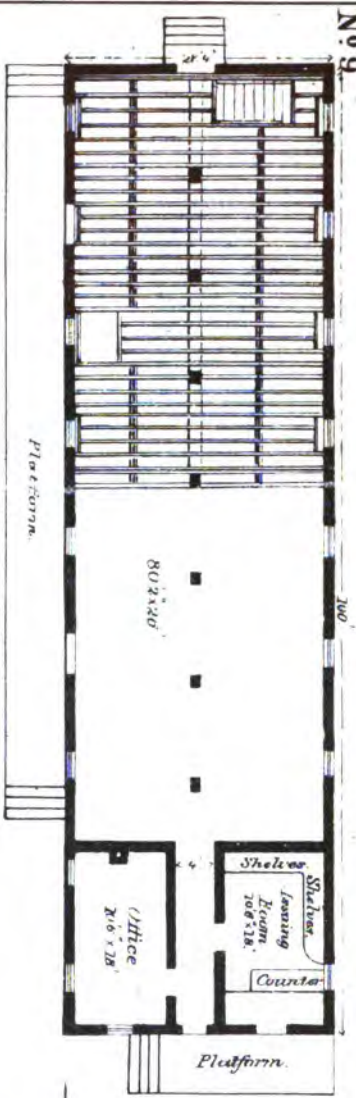


Rear Elevation.

Scale. 20 feet to inch.



No. 9

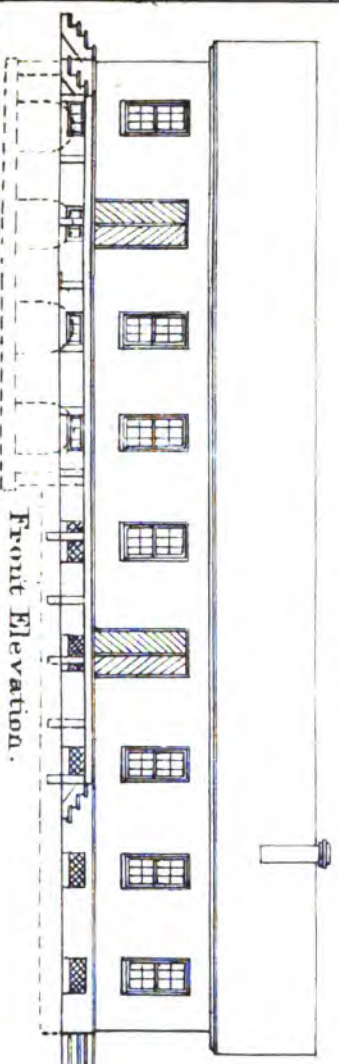
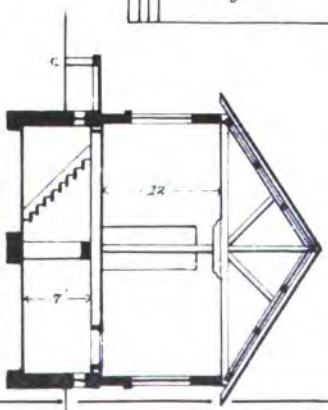


Ground Plan.

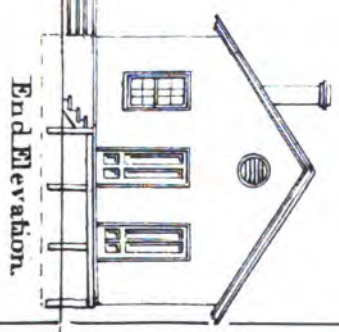
COMMISSARY STORE HOUSE.

Scale, 20 feet to inch.

Cross Section.



Front Elevation.

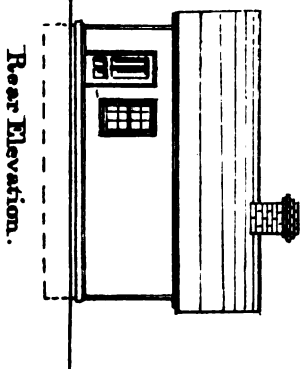
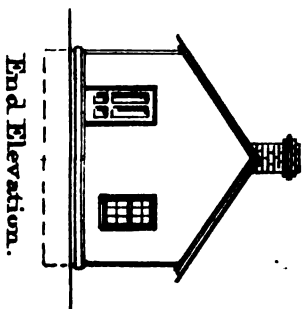
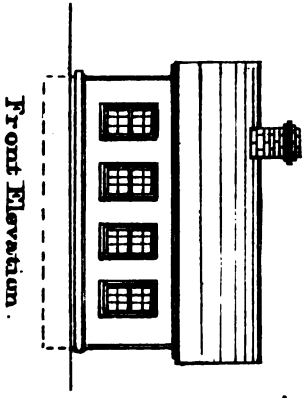
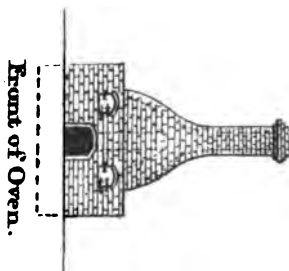
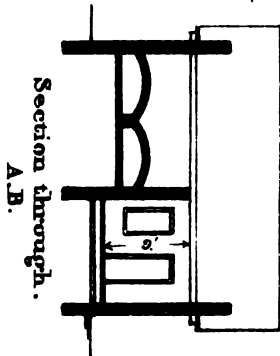
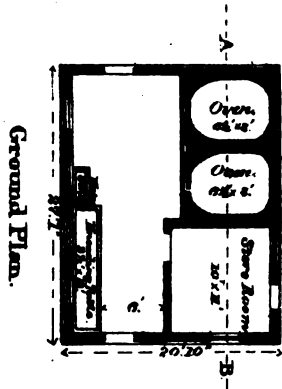


End Elevation.

Nº 10.

BAKE HOUSE.

Scale. 20 feet to 1 inch.



9.—*List of number of interments of Union soldiers in national military cemeteries.*

WAR DEPARTMENT,
QUARTERMASTER-GENERAL'S OFFICE,
Washington, D. C., ———, 1872.

SIR: I inclose herewith "List of national cemeteries, &c., with number of graves in each," for which head-stones are needed, under act of Congress of June 8, 1872; also, "Information for bidders."

No size, kind of stone, or style of letter is prescribed. The law requires the War Department to invite proposals for head-stones. From the designs and samples devised and submitted by the bidders, the Secretary of War will make a selection, as required by the law, which has been distributed to all who have asked for it. This is all the information communicated to the Quartermaster-General.

Very respectfully, your obedient servant,

M. C. MEIGS,
Quartermaster-General, Brevet Major-General, U. S. A.

List of number of interments of Union soldiers in national military cemeteries and in cemeteries other than national.

LIST OF NATIONAL CEMETERIES IN THE UNITED STATES.

Name of cemetery.	Location.	Number of interments of known remains.	Number of interments of unknown remains.	Total number of interments.
Cypress Hills Cemetery.....	On Long Island, eight miles from New York City.	3,533	81	3,634
Beverly Cemetery.....	One and a half miles from Beverly, N. J.....	147	.....	147
Brattleborough Cemetery.....	At Brattleborough, Vt.....	18	1	19
White Hall Cemetery.....	Near Bristol, seventeen miles from Philadelphia.	61	.....	61
National cemeteries.....	At Philadelphia, Pa.....	1,856	55	1,911
Rural Cemetery.....	At Chester, Pa., one mile from railway-station.	50	3	53
Harrisburgh Cemetery.....	At Harrisburgh, Pa.....	117	23	140
Prospect Hill Cemetery.....	At York, Pa., one-half mile from railway-station	151	2	153
Antietam Cemetery.....	One-half mile from Sharpsburgh, Md.....	1,792	2,903	4,695
Annapolis Cemetery.....	One-fourth mile from Annapolis, Md.....	2,309	195	2,504
Culpeper Court-House Cemetery.	At Culpeper Court-House, Va.....	447	902	1,349
City Point Cemetery.....	One and one-half miles from City Point, Va.....	3,719	1,437	5,156
Cold Harbor Cemetery.....	Eleven and one-half miles from Richmond, Va.	674	1,248	1,922
Danville Cemetery.....	At Danville, Va.....	1,171	148	1,319
Fredericksburgh Cemetery.....	At Fredericksburgh, Va., one mile from the railway-station.	2,508	12,734	15,242
Fort Harrison Cemetery.....	Eight miles from Richmond, Va.....	239	575	814
Glendale Cemetery.....	Fifteen miles from Richmond, Va.....	235	957	1,192
Hampton Cemetery.....	One-half mile from Hampton, Va.....	4,670	492	5,162
Poplar Grove Cemetery.....	Five miles from Petersburg, Va.....	2,050	4,137	6,187
Richmond Cemetery.....	Three and one-half miles from Richmond, Va.....	845	5,684	6,529
Staunton Cemetery.....	One and one-fourth miles from Staunton, Va.....	230	518	748
Seven Pines Cemetery.....	Nine miles from Richmond, Va.....	128	1,229	1,357
Winchester Cemetery.....	One-fourth mile from Winchester, Va.....	2,093	2,339	4,432
Yorktown Cemetery.....	One-half mile from Yorktown, Va.....	748	1,434	2,182
Grafton Cemetery.....	One-fourth mile from Grafton, W. Va.....	633	620	1,253
London Park Cemetery.....	Three miles from Baltimore, Md.....	1,380	83	1,463
New Berne Cemetery.....	One mile from New Berne, N. C.....	2,192	1,063	3,245
Raleigh Cemetery.....	One mile from Raleigh, N. C.....	604	557	1,161
Salisbury Cemetery.....	One-half mile from Salisbury, N. C.....	85	12,097	12,112
Wilmington Cemetery.....	One mile from Wilmington, N. C.....	696	1,361	2,057
New Albany Cemetery.....	At New Albany, Ind.....	2,130	676	2,806
Crown Hill Cemetery.....	Three miles from Indianapolis, Ind.....	673	36	708
Arlington Cemetery.....	Three miles from Washington, D. C.....	11,509	4,076	15,585
Alexandria Cemetery.....	At Alexandria, Va.....	3,635	.....	3,635
Ball's Bluff Cemetery.....	On the Potomac River, opposite Edward's Ferry.	1	53	54
Soldiers' Home Cemetery.....	Two miles from Washington, D. C.....	5,210	278	5,488
Battle Cemetery.....	Four miles from Washington, D. C.....	40	.....	40
Florence Cemetery.....	One mile from Florence, S. C.....	165	2,767	2,932
Beaufort Cemetery.....	Three-fourths mile from Beaufort, S. C.....	5,465	3,607	9,072
Mobile Cemetery.....	At Mobile Ala.....	498	347	845
Barrancas Cemetery.....	Near Fort Barrancas, Fla.....	1,000	383	1,383
Lebanon Cemetery.....	Two and one-half miles from Lebanon, Ky.....	583	283	866
Logan's Cross-Roads Cemetery.	At Mills Springs, Lincolnville, Ky.....	340	368	708
Camp Nelson Cemetery.....	Six miles from Nicholasville, Ky.....	2,459	1,179	3,638
Knoxville Cemetery.....	Three-fourths mile from Knoxville, Tenn.....	2,080	1,075	3,155
Chattanooga Cemetery.....	One and one-fourth miles from Chattanooga, Tenn.....	7,951	4,927	12,878
Nashville Cemetery.....	Six miles from Nashville, Tenn.....	12,495	4,002	16,497
Stone's River Cemetery.....	Three miles from Murfreesborough, Tenn.....	3,832	2,307	6,139
Fort Donelson Cemetery.....	One-half mile from Dover, Tenn.....	158	512	670
Memphis Cemetery.....	Six miles from Memphis, Tenn.....	5,149	8,916	13,965
Pittsburgh Landing Cemetery.....	Three and one-fourth miles from Shiloh, Tenn.....	1,234	2,356	3,590
Andersonville Cemetery.....	At Andersonville, Ga.....	12,812	902	13,714
Marietta Cemetery.....	At Marietta, Ga.....	7,050	3,035	10,094
Corinth Cemetery.....	Three-fourths mile from Corinth, Miss.....	1,796	3,869	5,667
Natchez Cemetery.....	One and one-half miles from Natchez, Miss.....	365	2,716	3,081
Vicksburg Cemetery.....	At Vicksburg, Miss.....	5,459	11,126	16,585
Chalmette Cemetery.....	Six miles from New Orleans, La.....	6,709	5,484	12,193
Baton Rouge Cemetery.....	At Baton Rouge, La.....	2,435	492	2,927
Alexandria Cemetery.....	One mile from Alexandria, La.....	518	763	1,281
Port Hudson Cemetery.....	One and one-half miles from Port Hudson, La.....	593	3,911	3,604
Brownsville Cemetery.....	Near Port Brown, Texas.....	1,338	1,501	2,839
Little Rock Cemetery.....	One and one-half miles from Little Rock, Ark.....	3,161	2,272	5,433
Fort Smith Cemetery.....	One-fourth mile from Fort Smith, Ark.....	568	946	1,514
Fayetteville Cemetery.....	One-half mile from Fayetteville, Ark.....	503	713	1,216
Jefferson Barracks Cemetery.....	On the military reserve of Jefferson Barracks, ten miles from Saint Louis, Mo.	8,353	1,887	10,240

List of number of interments of Union soldiers, &c.—Continued.

Name of cemetery.	Location.	Number of interments of known remains.	Number of interments of unknown remains.	Total number of interments.
Jefferson City Cemetery	At Jefferson City, Mo.....	340	330	670
Springfield Cemetery	Three miles from Springfield, Mo.....	836	710	1,546
Camp Butler Cemetery	Six miles from Springfield, Ill.....	1,021	346	1,367
Mound City Cemetery	One and one-half miles from Mound City, Ill.....	2,504	2,637	5,141
Rock Island Cemetery	On Rock Island, in the Missouri River.....	117	27	144
Fort Leavenworth Cemetery	One-half mile from Fort Leavenworth, Kans.....	417	676	1,093
Fort Scott Cemetery	One and one-half miles from Fort Scott, Kans.....	306	101	407
Fort Gibson Cemetery	At Fort Gibson, Indian Territory.....	157	1,972	2,129
Baxter Springs Cemetery	At Baxter Springs, Kans.....	124		124
Keokuk Cemetery	At Keokuk, Iowa.....	604	21	625
Total		150,914	136,773	286,687

LIST OF CEMETERIES OTHER THAN NATIONAL.

Name and place of cemetery.	Number of interments of known remains.	Number of interments of unknown remains.	Total number of interments.
Fort Schuyler, New York Harbor, New York	4		4
Fort Hamilton, New York Harbor, New York	42	99	141
Willet's Point, New York Harbor, New York	3	4	7
Sandy Hook, New York Harbor, New York	5	2	7
David's Island, New York Harbor, New York	25	11	36
Woodlawn, Elmira, New York	128		128
Bennington, Wyoming County, New York	11		11
Rural, Albany, New York	251	1	252
Fort Columbus, New York Harbor, New York	108	31	139
Fairmount, Newark, New Jersey	163		163
Fort Adams, Newport, Rhode Island	15	26	41
Fort Wadsworth, New York Harbor, New York	3		3
Plattsburgh Barracks, New York	5	95	100
Beechwood, New Rochelle, New York	32	1	33
Catholic, New Haven, Connecticut	8		8
Evergreen, New Haven, Connecticut	100		100
Oakwood, Lewisburgh, Connecticut	19		19
Fort Trumbull, New London, Connecticut	13		13
Rural, Worcester, Massachusetts	22		22
Pine, Worcester, Massachusetts	1		1
Saint John's, Worcester, Massachusetts	19		19
Pine Grove, Manchester, New Hampshire	6	4	10
Valley, Manchester, New Hampshire	16		16
City, Calais, New Hampshire	17		17
Rye Cemetery, Rye, New Hampshire	3		3
Robinson, New Hampshire	5		5
Old Cemetery, Concord, New Hampshire		10	10
Piscataqua, Manchester, New Hampshire	1		1
Stowell, Manchester, New Hampshire	2		2
Goff's Falls, Manchester, New Hampshire	2		2
Merrill, Manchester, New Hampshire	2		2
Portsmouth, New Hampshire	24		24
Greenland, New Hampshire	2		2
Burlington, Vermont	2		2
Montpelier, Vermont	2		2
Perry Cemetery, Perry, Maine	7		7
Fort Sullivan, Eastport, Maine	7		7
Forest City, Portland, Maine	19		19
Dedham, Massachusetts	64	1	65
Mount Hope, West Roxbury, Massachusetts	4		4
Woodlawn, Chelsea, Massachusetts	1		1
Garden City, Chelsea, Massachusetts	16		16
Hollywood, Brookline, Massachusetts	1		1
City Cemetery, Brookline, Massachusetts	3		3
Catholic, Cambridge, Massachusetts	1		1
Gallop's Island, Boston Harbor, Massachusetts	13		13

List of number of interments of Union soldiers, &c.—Continued.

Name and place of cemetery.	Number of interments of known remains.	Number of interments of unknown remains.	Total number of interments.
Hope, Worcester, Massachusetts	20		20
City, Cambridge, Massachusetts	19		19
Fort Porter, Buffalo, New York	7		7
Fort Niagara, Youngstown, New York	22	2	24
Fort Ontario, Oswego, New York	4	32	26
Madison Barracks, Sackett's Harbor, New York	30	547	577
Forrest Lawn, Buffalo, New York	28		28
Limestone Hill, Buffalo, New York	6	4	10
Pine Hill, Buffalo, New York	12		12
Cold Spring, Lockport, New York	8	1	9
Mount Hope, Rochester, New York	14		14
Lodi, Seneca County, New York	5		5
Cherry Creek, Chautauqua, New York	10		10
Soranton, Luzerne County, Pennsylvania	6		6
Saint James Episcopal, Bristol, Pennsylvania	17	1	18
Rural, Chester, Pennsylvania	33	3	35
Saint Michael's, Chester, Pennsylvania	3		3
Odd Fellows, Tamaqua, Pennsylvania	6		6
German Reformed and Lutheran, Tamaqua, Pennsylvania	4		4
Springfield, Shippensburg, Pennsylvania	14		14
Lutheran, Shippensburg, Pennsylvania	3		3
Cemetery two miles from Shippensburg, Pennsylvania	3		3
Easton Cemetery, Easton, Pennsylvania	27		27
Arndt's, Easton, Pennsylvania	6		6
Hay's, Easton, Pennsylvania	4		4
First Presbyterian, Easton, Pennsylvania	2		2
German Reformed, Easton, Pennsylvania	4		4
German Catholic, Easton, Pennsylvania	3		3
Lutheran, Hollidaysburgh, Pennsylvania	11		11
Presbyterian, Hollidaysburgh, Pennsylvania	9		9
Catholic, Hollidaysburgh, Pennsylvania	1		1
Asbury, Hollidaysburgh, Pennsylvania	1		1
Dunkard, Hollidaysburgh, Pennsylvania	1		1
Phillipsburgh, Pennsylvania	5		5
Methodist Episcopal, Mercersburgh, Pennsylvania	4		4
Presbyterian, Mercersburgh, Pennsylvania	3		3
Union, Upton, Pennsylvania	4		4
Lackawaxen, Pike County, Pennsylvania	16		16
Allogheny, Pennsylvania	98	9	107
Ashland, Carlisle, Pennsylvania	38		38
Cedar Grove, Chambersburgh, Pennsylvania	32	10	42
Finn's Point, New Jersey	10		10
Pea Patch Island, Delaware	2		2
Wilmington and Brandywine, Delaware	39		39
Old Swede's, Wilmington, Delaware	2	3	5
Zion Methodist Episcopal, Wilmington, Delaware	1		1
Asbury Chapel, Wilmington, Delaware	6		6
Saint Mary's Catholic, Wilmington, Delaware	5	5	10
Mount Lebanon Methodist Episcopal, Wilmington, Delaware	2		2
Newark Methodist Episcopal, Wilmington, Delaware	1		1
Mount Pleasant Methodist Episcopal, Wilmington, Delaware	3		3
Saint Peter's Methodist Episcopal, Wilmington, Delaware	2	1	3
Mount Salem Methodist Episcopal, Wilmington, Delaware	3		3
Newport Methodist Episcopal, Wilmington, Delaware	1		1
Saint James Methodist Episcopal, Wilmington, Delaware	6		6
Presbyterian, Wilmington, Delaware	2		2
Friends, Wilmington, Delaware	1		1
Saint Mary's Catholic, Pittsburg, Pennsylvania	22		22
Rose Hill, Chicago, Illinois	255	62	317
Oakwood, Chicago, Illinois		9	9
Spring Grove, Cincinnati, Ohio	974	21	993
Oakhill, Evansville, Indiana	591	121	712
Greenlawn, Columbus, Ohio	449	43	492
Gallipolis, Ohio	84	74	158
Woodland, Cleveland, Ohio	36	2	38
Elmwood, Detroit, Michigan	62		62
Jackson, Michigan	26	3	29
Oakhill, Sandusky, Ohio	20	7	27
Oakhill, Grand Rapids, Michigan	35	26	61
Oakhill, Janesville, Wisconsin	13		13
Forest Hill, Madison, Wisconsin	222	2	224
Mound, Racine, Wisconsin	39	1	40
Crownhill, Racine, Wisconsin	13		13
Kenosha, Wisconsin	3		3

List of number of interments of Union soldiers, &c.—Continued.

Name and place of cemetery.	Number of interments of known remains.	Number of interments of unknown remains.	Total number of interments.
Forrest Home, Milwaukee, Wisconsin	21		21
Fort Crawford, Prairie du Chien, Wisconsin	17		17
Green Bay, Wisconsin	3		3
Oshkosh, Wisconsin	7		7
Rienzi, Fond du Lac, Wisconsin	12		12
Joliet, Wisconsin	2		2
Dundee, Illinois	10		10
Elgin, Illinois	15		15
Rockford, Illinois	17		17
Saint Charles, Illinois	12		12
Dixon, Illinois	16		16
Woodland, Quincy, Illinois	236	6	242
Alton, Illinois	149	12	161
Fort Wayne, Michigan	2	21	23
Ripon, Indiana	9		9
Litewood, Fort Wayne, Indiana	17		17
Ohio Township, Bartholomew County, Indiana	1		1
Thornton, Indiana	19		19
Sugar Ridge Township, Clay County, Indiana	2		2
Center Point, Clay County, Indiana	4		4
Crawford County, Indiana	6		6
Perry Township, Clay County, Indiana	1		1
Miller Township, Dearborn County, Indiana	3		3
Creamer Creek Township, Dearborn County, Indiana	2		2
Harrison Township, Dearborn County, Indiana	4		4
Logan Township, Dearborn County, Indiana	1		1
Decatur, Indiana	8		8
Methodist, Decatur, Indiana	4		4
DeKalb County, Indiana	6		6
Spencerville, Indiana	1		1
Fountain City, Indiana	4		4
Portland County, Indiana	1		1
Ebenezer Chapel, Bloomington, Indiana	1		1
Pepperton, Franklin County, Indiana	1		1
Metamora, Franklin County, Indiana	1		1
Trenton, Franklin County, Indiana	2		2
Lebanon, Greene County, Indiana	3		3
Shiloh, Clay County, Indiana	1		1
Ellenoe's Burial Ground, Greene County, Indiana	1		1
Hanoh's Burial Ground, Greene County, Indiana	1		1
Greene County, Indiana	1		1
Ellenworth Burial Ground, Greene County, Indiana	1		1
Friendly Grove, Clay County, Indiana	1		1
Bradford, Harrison County, Indiana	2		2
Harrison County, Indiana	1		1
Lisbon, Henry County, Indiana	3		3
Dublin, Wayne County, Indiana	3		3
Spiceland, Henry County, Indiana	10		10
Stony Creek Township, Henry County, Indiana	4		4
Jefferson Township, Henry County, Indiana	4		4
Blue River, Henry County, Indiana	3		3
Wayne, Henry County, Indiana	11		11
Franklin Township, Henry County, Indiana	5		5
Dudley Township, Henry County, Indiana	3		3
Liberty Township, Henry County, Indiana	2		2
Henry Township, Henry County, Indiana	9		9
Greensborough Township, Henry County, Indiana	2		2
Harrison Township, Henry County, Indiana	15		15
Fall Creek Township, Henry County, Indiana	8		8
Prairie Township, Henry County, Indiana	7		7
Walcotville, Lagrange County, Indiana	1		1
Springville, Lawrence County, Indiana	7		7
Lawrence County, Indiana	1		1
Greene County, Indiana	1		1
Mount Carmel, Madison County, Indiana	1		1
Alfolt, Madison County, Indiana	1		1
Cumberland, Madison County, Indiana	2		2
Hancock County, Indiana	1		1
Marion County, Indiana	1		1
At Home, Marion County, Indiana	8		8
Monroe County, Indiana	1		1
Montgomery County, Indiana	12		12
Lisbon, Noble County, Indiana	1		1
Noble County, Indiana	1		1

List of number of interments of Union soldiers, &c.—Continued.

Name and place of cemetery.	Number of interments of known remains.	Number of interments of unknown remains.	Total number of interments.
Evansville, Ohio County, Indiana.....	1		1
Rising Sun, Ohio County, Indiana.....	18		18
Paoli, Orange County, Indiana.....	6		6
Gosport, Owen County, Indiana.....	8		8
Spencer, Owen County, Indiana.....	1		1
Owen County, Indiana.....	4		4
Catlin, Parke County, Indiana.....	4		4
Parke County, Indiana.....	5		5
Shelbyville, Shelby County, Indiana.....	2		2
At Home, Sullivan County, Indiana.....	4		4
New Lebanon, Sullivan County, Indiana.....	3		3
Evansville, Sullivan County, Indiana.....	1		1
Sullivan County, Indiana.....	1		1
Allansville, Switzerland County, Indiana.....	1		1
Bennington County, Indiana.....	5		5
Patriot County, Indiana.....	1		1
Vigo County, Indiana.....	3		3
Washington, Vigo County, Indiana.....	1		1
At Home, Vigo County, Indiana.....	5		5
Pine Village, Warren County, Indiana.....	3		3
Hope, Washington County, Indiana.....	2		2
Hillsborough, Wayne County, Indiana.....	3		3
Elkhorn, Wayne County, Indiana.....	1		1
Centerville, Wayne County, Indiana.....	1		1
Richmond, Wayne County, Indiana.....	11		11
Cambridge, Wayne County, Indiana.....	6		6
Talton Township, Wayne County, Indiana.....	1		1
Washington, Wayne County, Indiana.....	3		3
Harrison Township, Wayne County, Indiana.....	1		1
Milton Township, Wayne County, Indiana.....	1		1
Haystown, Wayne County, Indiana.....	1		1
Abington Township, Wayne County, Indiana.....	1		1
Wayne County, Indiana.....	2		2
Elmwood, Columbia, South Carolina.....	15	8	23
Danville, Kentucky.....	350	5	355
Galveston, Chapel Hill, and Hempstead, Texas.....	39	20	59
Centralia, Missouri.....		87	87
Arsenal Island, Saint Louis, Missouri.....		540	540
Alton, Illinois.....	151	12	163
Small-pox Island, Illinois.....		82	82
Barnesville, Kansas.....	8	10	18
Mound City, Kansas.....	15	15	30
Geneva, Kansas.....	5		5
Olathe, Kansas.....	8	1	9
Iola, Kansas.....	5	1	6
Paola, Kansas.....	11	7	18
Ottumwa, Kansas.....	4		4
Marmiton, Kansas.....	4		4
Topeka, Kansas.....	23		23
Louisville, Kansas.....	4	1	5
Ossawatimie, Kansas.....	4	2	6
Fort Riley, Kansas.....	73	39	112
Fort Wallace, Kansas.....	66		66
Fort Hayes, Kansas.....	72	5	77
Fort Larned, Kansas.....	43	19	62
Fort Dodge, Kansas.....	72		72
Fort Lyon, Colorado Territory.....	11	150	161
Fort Wingate, New Mexico Territory.....	2	70	72
Fort Garland, Colorado Territory.....	1	59	60
Fort McRae, New Mexico Territory.....	10	50	60
Fort Selden, New Mexico Territory.....	5	77	82
Fort Sumner, New Mexico Territory.....	20	180	200
Fort Stanton, New Mexico Territory.....	15	85	100
Fort Bascom, New Mexico Territory.....	14	58	72
Fort Bayard, New Mexico Territory.....	4	56	60
Fort Lowell, New Mexico Territory.....	1	59	60
Fort Union, New Mexico Territory.....	50	250	300
Fort Craig, New Mexico Territory.....	163	87	250
Fort Cummings, New Mexico Territory.....	35	45	80
Santa Fé, New Mexico Territory.....		312	312
Fort Fillmore, New Mexico Territory.....	1	94	95
Los Pinos, New Mexico Territory.....	18	1	19
Los Limas, New Mexico Territory.....	3		3
Albuquerque, New Mexico Territory.....	7		7

List of number of interments of Union soldiers, &c.—Continued.

Name and place of cemetery.	Number of interments of known remains.	Number of interments of unknown remains.	Total number of interments.
Sioux City, Iowa.....	5		5
Fort Kearney, Nebraska.....	32	219	251
Fort McPherson, Nebraska.....	39	44	83
Fort Sedgwick, Colorado Territory.....	37	29	66
Fort Morgan, Colorado Territory.....	3	7	10
Fort D. A. Russell, Wyoming Territory.....	16	5	21
Fort Sanders, Wyoming Territory.....	29		29
Fort Bridger, Wyoming Territory.....	18		18
Fort Fred Steele, Wyoming Territory.....	2		2
Fort Laramie, Wyoming Territory.....	29	137	156
Fort Fetterman, Wyoming Territory.....	6		6
Fort Reno, Wyoming Territory.....	28	3	31
Fort Phil Kearney, Wyoming Territory.....	97	12	109
Camp Douglas, Utah Territory.....	63	1	64
Fort Snelling, Minnesota.....	41	69	110
Fort Ripley, Minnesota.....	18	12	30
Fort Wadsworth, Dakota Territory.....	18	5	23
Total.....	7,362	4,323	11,685
RECAPITULATION.			
In national cemeteries.....	150,914	136,773	286,687
In cemeteries other than national.....	7,362	4,323	11,685
Total in the United States.....	167,276	141,096	308,372

INFORMATION FOR BIDDERS FOR FURNISHING HEAD-STONES FOR NATIONAL MILITARY CEMETERIES.

Proposals for head-stones for national military cemeteries.

WAR DEPARTMENT, QUARTERMASTER-GENERAL'S OFFICE.

Washington, D. C., August 1, 1872.

Proposals are invited for marking the graves in the national cemeteries as required by law, to be addressed to the Quartermaster-General, Washington, D. C.

Proposals should state the price for each head-stone, properly inscribed, and set at the head of the grave, in each national military cemetery.

Bids may be for the whole work of all the cemeteries, or for that of several cemeteries in a district, or for a single cemetery.

The bonds required will be in amount twenty (20) per cent. of the total amount of each contract.

All proposals received by the Quartermaster-General will be opened on the 12th day of October, 1872, at noon, at the office of the Quartermaster-General, Washington, D. C., in presence of bidders, and contracts will be awarded to the lowest responsible bidders, as soon as the comparison of the samples and prices can be completed, provided the samples are deemed suitable by the Secretary of War.

All samples should be distinctly marked in order to prevent mistakes.

List of the cemeteries, with the number of graves in each, together with full information as to conditions, requirements, &c., will be furnished on application in writing to the Quartermaster-General, at Washington, D. C.

Envelopes containing proposals should be indorsed, "Proposals for head-stones for national military cemeteries," and addressed to the Quartermaster-General, Washington, D. C.

Extract from the law of 8th June, 1872.

The Secretary of War shall cause each grave to be marked with a small head-stone, with the name of the soldier and the name of his State inscribed thereon, when the

same are known, in addition to the number required to be inscribed by said section, (section 1 of act of 22d February, 1867;) and he shall, within ninety days from the passage of this act, advertise for sealed proposals of bids for the making and erection of such head-stones, which advertisements shall be made for sixty days, successively, in at least twenty newspapers of general circulation in the United States, and shall call for bids for the doing of said work, in whole or in part; and upon the opening of such bids, the Secretary of War shall, without delay, award the contracts to the lowest responsible bidders or bidder, in whole or in part; and said bidders shall give bonds to his satisfaction for the faithful completion of the work.

Section 1 of act of 22d February, 1867.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That in the arrangement of the national cemeteries established for the burial of deceased soldiers and sailors, the Secretary of War is hereby directed

to cause each grave to be marked with a small head-stone, or block, with the number of the grave inscribed thereon, corresponding with the number opposite to the name of the party in a register of burials to be kept at each cemetery and at the office of the Quartermaster General.

REQUIREMENTS.

Each proposal should be accompanied by a sample of the stone proposed to be used; said sample to be finished complete, so as to show the size of the head-stone, the form and style and size of the lettering, and the quality of the material offered.

The inscriptions will give the number of the grave, the name of the soldier, his company, regiment, rank, and State, and the date and place of death, when these are known. When none of these are known the head-stone will be marked with the number of the grave and the inscription, "Unknown," "U. S. Soldier," thus:

3,269.

JOHN SMITH.

Corporal,

Co. B, 10th Ohio Vols.

Died 25th November, 1863.

Chattanooga, Tenn.

Or,

2,467.

Unknown.

U. S. Soldier.

By order of the Secretary of War.

M. C. MEIGS,
Quartermaster-General, *Brevet Major-General, U. S. A.*

REPORT OF THE COMMISSARY-GENERAL OF SUBSISTENCE.

19 w



REPORT

OF THE

COMMISSARY-GENERAL OF SUBSISTENCE.

OFFICE OF COMMISSARY-GENERAL OF SUBSISTENCE,
Washington City, October 5, 1872.

SIR: I have the honor to submit the following report of the operations of the Subsistence Department of the Army for the fiscal year terminating June 30, 1872:

No changes of special importance or magnitude have taken place in the mode of subsisting the Army during the past year, the sources and methods of supply having, since the war, been gradually brought into close conformity with the customary usages governing in commercial transactions. A responsible officer is placed at the headquarters of each of the three military divisions and eleven military departments into which the whole territory of the United States is divided, who, under the General Regulations of the Army, the instructions of this office, and the orders of the commanding generals of such divisions and departments, is charged with supplying the troops of their respective commands.

There being three vacancies in the Subsistence Department, the number of its officers is now twenty-six. Of these, one colonel and two lieutenant-colonels, assistant commissaries-general, are stationed at the headquarters of the Divisions of the Atlantic, the Pacific, and the Missouri. Ten commissaries, of the rank of major and captain, are stationed at the headquarters of the Military Departments of the East, the Lakes, Dakota, the Platte, the Missouri, Texas, California, the Columbia, the South, and the Gulf. Most of these officers, besides performing the duties of chief commissary of their several headquarters, usually also perform purchasing and depot duties. Of the remaining officers of the Department—thirteen—four are on duty in the Subsistence Bureau, eight are stationed at important points of purchase or at depots, as Washington, Baltimore, Saint Louis, Chicago, Sioux City, Pueblo, Santa Fé, and Cheyenne, one being on leave. An officer of cavalry is temporarily performing the duty of chief commissary at the headquarters of Arizona.

A terrible conflagration having laid in ashes a large part of the city of Chicago, the Subsistence Department was, under the telegraphic instructions of the Secretary of War to Lieutenant-General P. H. Sheridan, United States Army, dated October 9, 1871, called upon to furnish and distribute food to the sufferers by that calamity. Accordingly, supplies were hurried forward from Saint Louis and Cincinnati, but the magnificent contributions by the people for their suffering fellow-citizens, soon poured into Chicago from all quarters so freely that the sum of \$5,705.83 only was expended for this purpose by the Subsistence Department. The supplies sent to Chicago were, however, most opportunely there, to meet a call from the governor of Wisconsin for the sufferers by the forest-fires which swept over portions of that State. For this purpose, Lieutenant-General Sheridan, under the authority of the Secretary of War, of November 15, 1871, caused food valued at

\$30,836.11 to be issued to the governor, "on condition that the State of Wisconsin will account for the stores at their value if required to do so hereafter."

During the fiscal year ending June 30, 1872, there were reported to this office 198 advertisements inviting proposals for furnishing supplies, 336 contracts for fresh beef, 75 contracts for complete rations, 159 contracts for miscellaneous articles, and 370 contracts consisting of written proposals and acceptances. In order promptly to meet the requirements of the troops, it is occasionally necessary to make purchases in the open market. When this is done the purchasing officers take the customary means for obtaining their supplies at the lowest market rates for kind and quality of articles purchased. The average prices paid for fresh beef, under contracts made during the year, were as follows, for the several States and Territories:

States or Territories.	Cents per pound.	States or Territories.	Cents per pound.	States or Territories.	Cents per pound.
Maine.....	13.15	Alabama.....	7.10	Dakota Territory.....	9.83
Massachusetts.....	13.83	Louisiana.....	9.00	Wyoming Territory.....	9.43
Rhode Island.....	13.16	Texas.....	5.57	New Mexico Territory.....	9.33
Connecticut.....	11.23	Tennessee.....	8.04	Colorado Territory.....	8.37
New York.....	11.75	Kentucky.....	7.83	Utah Territory.....	10.26
Pennsylvania.....	11.12	Ohio.....	9.25	Montana Territory.....	11.12
Maryland.....	11.50	Illinois.....	8.56	California.....	10.89
District of Columbia.....	12.00	Michigan.....	12.06	Oregon.....	9.29
Virginia.....	10.96	Missouri.....	5.00	Arizona Territory.....	12.68
North Carolina.....	10.77	Minnesota.....	10.18	Washington Territory.....	12.43
South Carolina.....	11.23	Nebraska.....	7.54	Idaho Territory.....	13.50
Georgia.....	10.83	Kansas.....	9.56	Nevada.....	19.12
Florida.....	8.12	Indian Territory.....	7.62		

Making the average contract price for the year 10.36 cents per pound net.

The monthly average cost of the established Army ration at the principal points of purchase was for the fiscal year ending June 30, 1872, as follows:

Months.	New York, N. Y.	Baltimore, Md.	Louisville, Ky.	Saint Louis, Mo.	Saint Paul, Minn.	Omaha, Nebr.	Fort Leavenworth, Kana.	Chicago, Ill.	New Orleans, La.	San Francisco, Cal.
1871.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.
July.....	15.89	19.57	17.57	15.77	16.72	16.73	16.80	15.46	16.28	20.82
August.....	16.49	19.47	.....	15.12	16.80	16.71	16.79	15.30	15.78	20.68
September.....	15.15	19.77	16.89	14.22	16.42	16.42	16.62	16.01	16.25	20.97
October.....	15.04	19.05	17.30	15.97	15.98	16.26	16.11	16.66	16.18	21.33
November.....	14.73	17.36	17.40	15.65	17.00	16.01	17.64	16.43	17.00	21.19
December.....	15.47	20.69	16.86	15.62	17.02	16.14	16.71	16.46	15.75	20.72
1872.										
January.....	15.52	19.67	16.59	15.52	16.97	16.15	17.53	15.80	16.28	20.57
February.....	15.43	20.06	16.67	15.73	17.05	16.13	17.18	15.23	17.45	20.08
March.....	15.73	20.69	16.62	14.65	16.33	16.14	18.19	15.27	17.04	18.86
April.....	15.29	22.14	16.29	16.72	16.98	16.01	18.05	14.74	18.26	18.84
May.....	16.85	20.79	16.83	15.38	16.73	15.79	17.73	16.15	18.99	19.42
June.....	16.48	20.43	17.17	15.70	16.74	15.76	17.10	15.62	16.97	19.88
Average.....	15.67	19.93	17.16	15.52	16.72	16.19	17.20	15.76	17.02	20.30

Making the general average for the year seventeen cents and fourteen hundredths per ration, being a decrease of two cents and forty-two hundredths from the average for the previous year.

As required by law, (section 6, act of March 3, 1865,) the Subsistence Department has furnished tobacco for sale to enlisted men of the Army at cost price. From the returns received at this office, and transmitted to the Paymaster-General, it appears that during the year the sales of tobacco to troops amounted to \$157,113.24, making an average of \$13,092.72 per month, and indicating that fully two-thirds of the enlisted men availed themselves of the means the Government thus affords them of obtaining this article. As the Government is repaid by the soldier for the tobacco supplied him, it is deemed right to meet his demands by furnishing him with the best article of plug-tobacco offered in response to advertisements for proposals.

The Freedmen's Hospital, at Washington, D. C., has, during the year, been furnished, on requisitions of the Commissioner of Refugees, Freedmen, &c., with subsistence stores valued at \$31,630.36. Of this amount the sum of \$10,303.49 has been repaid, leaving a balance of \$21,326.87 due the Subsistence Department.

Under the provisions of section 16 of the act of June 30, 1834, and paragraph 1202, Revised Regulations for the Army, 1863, subsistence supplies valued at \$89,048.12 have, in the discretion of commanding officers, been issued to Indians of the various tribes visiting the military posts on the frontier, or in their respective nations, no part of which amount is returned to the appropriation for the subsistence of the Army.

Issues of subsistence stores to Indians have also been made under proper instructions and to meet special emergencies, as follows:

In Arizona, valued at.....	\$81,787 29
At Camp McDermitt, Nevada, valued at.....	3,358 71
At Camp Harney, Oregon, valued at.....	3,037 47
At Grand River agency, Dakota Territory, valued at.....	2,492 10
At Fort Yuma, California, valued at.....	659 04
At Big Springs, Nebraska, valued at.....	821 58
At Sidney Barracks, Nebraska, valued at.....	1,119 68
At Forts Fetterman and Laramie, Wyoming Territory, valued at.....	9,862 12

103,137 99

Of which the following sums have been repaid by the Indian Department:

For Forts Laramie and Fetterman, Wyoming Territory.....	\$9,862 12
For Sidney Barracks, Nebraska.....	1,119 68

10,981 80

Leaving, for future settlement, \$93,018.31.

During the fiscal year there were received from 513 different officers of the Army, who have been on duty in the Subsistence Department, and who were responsible for subsistence funds or supplies, the following monthly and quarterly papers, each with its appropriate vouchers:

Returns of provisions.....	2,990
Returns of commissary property.....	1,107
Accounts-current.....	3,109

Making a total of..... 7,206

Of which—

Returns of provisions.....	2,747
Returns of commissary property.....	1,050
Accounts-current.....	2,790

Making a total of..... 6,587

Have been examined and forwarded to the Third Auditor of the Treas-

ury for final settlement, leaving in this office, for examination or awaiting correction, 619 accounts and returns. These accounts and returns indicate considerable improvement in promptness of rendition and general accuracy upon those of the previous year.

Under the act of June 23, 1870, authorizing the proper accounting officers of the Treasury in the settlement of certain accounts of disbursing officers of the Army and Navy, to allow such credits for overpayments, and for losses of funds, vouchers, or property, as they may deem just and reasonable, when recommended under authority of the Secretaries of War and Navy, by the head of the Military and Naval Bureaus, to which such accounts respectively pertain, credits have, during the past fiscal year, been recommended in the cases of 370 officers, involving the sum of \$109,320.79. Since the passage of the act credits have been recommended in the cases of 410 officers, involving \$127,452.09.

Up to the 30th day of September last 5,877 claims, amounting to \$3,200,677.37, had been submitted for examination under the third section of the act of July 4, 1864, for subsistence taken or furnished during the war for Army use in States not in rebellion. One hundred and five of these, accompanied by regular vouchers given by the officers when purchasing the stores, have been recommended for payment, in the aggregate sum of \$9,152.75, by the Third Auditor of the Treasury, as purchases under contract; 1,261 others (aggregating \$411,440.73) have been recommended to him for settlement under the act, in the aggregate amount of \$295,554.42, and 4,400, amounting to \$2,664,939.70, have been examined and disallowed. The act under which these claims are presented has now been in force upwards of eight years, and it is believed the great mass, if not all, of the well-founded claims that come within the terms of the third section have been filed. And it is apparent, without argument, that the task, originally very difficult, of investigating and deciding these cases with equity and justice, becomes daily more so from the passing away by deaths and removals, and from the imperfect memories after the lapse of so long a period, of so many officers and others alleged to have taken or received the stores, or to have knowledge of them in cases still being presented or called up for a re-examination, while these very difficulties but add security, if not increased facilities, to the prosecution of fraudulent claims. The expediency is therefore suggested of recommending to Congress to set a future but not distant day as a limit, after which claims shall not be presented to or received at this office under this act, and another day, not later than twelve months thereafter, for the termination of all action by this office on claims under this law. The number of certificates received and paid up to the 30th of September, 1872, is 6,525, amounting to \$287,318, for commutation of rations to Union soldiers, prisoners of war, and their heirs, under the joint resolution of July 25, 1866, and section 3 of the act of March 2, 1867.

The necessities of the service at every military post have always required the services of at least one man to assist the commissary in his duties. Now that the Subsistence Department is required by law (section 25, act of July 28, 1866) to keep on hand and sell, to officers and enlisted men of the Army, certain goods formerly supplied by sutlers, the quantity and variety of stores for which the commissary is responsible is greatly increased, as is also the labor connected with receiving, storing, overhauling, invoicing, issuing, selling, and accounting for them. The commissary, as a necessary consequence, now needs, more than ever, a reliable, intelligent, expert man to assist him. Under existing laws and regulations there are but two means of obtaining such assistance:

1st, by hiring civilians; 2d, by details from the enlisted men of the Army. The first, besides other objections, is the most expensive, so costly in fact as to preclude its use except in rare and exceptional cases. The second, which, from necessity, is that resorted to in nearly all cases, is objectionable, from the fact that the commissary is rarely able by it to obtain reliable men having the proper requirements, and also from the fact that such details are from their nature but temporary and frequently changed, thus affording the commissary as a rule only inferior, unreliable, and unskilled assistance. It is scarcely just to the young subaltern officers of the Army, most of whom before being assigned to duty in the Subsistence Department have had little or no experience in the purchase, preservation, handling, issuing, or selling of subsistence stores, and who become and are held officially and pecuniarily responsible to the Government for all such stores as are placed in their charge, to hold them to a rigid pecuniary accountability at the Treasury, without providing them with at least one reliable assistant. For the want of such reliable assistants there are frequent losses of stores. Such losses, until they can be proved to have taken place without prejudice to the officers nominally responsible, stand charged to them. In the interest of the Treasury, and in that of the junior officers of the Army and of the soldiers, some means should be provided for giving to each of those officers who are by the necessities of the service forced to become responsible for subsistence supplies at least one reliable assistant—for the Treasury, to save money; for the young officer, to enable him to perform his duties more satisfactorily and with less pecuniary loss to himself; for the soldier, that the food placed at his post may be more surely preserved and reach him in good wholesome condition. The want of such an assistant to each post-commissary is the greatest evil with which the Department has now to contend in its important ministrations. To remedy it, I recommend that Congress may be asked to authorize the Secretary of War to select from the non-commissioned officers of the Army who shall have faithfully served therein at least five years, three years of which in the grade of non-commissioned officer, as many persons, to be by him appointed *commissary-sergeants*, as the service may require, not to exceed one for each military post or place of deposit of commissary stores, whose duty it shall be, under the orders of the proper officer of the Subsistence Department, to assist in receiving, preserving, issuing, selling, and duly accounting for, under such regulations as shall be prescribed, all stores pertaining to the Subsistence Department that may be placed under their charge, and who shall receive for their services the pay and allowances of ordnance-sergeants. This would make a small addition to the enlisted force of the Army, but I have no hesitation in expressing the opinion that as a result it would lessen the total expenses of the Government for its support, as by the constant care and skill of well-selected commissary-sergeants the large quantities of stores now lost for want of such care and skill would be saved for issue.

I have the honor to be, very respectfully, your obedient servant,

A. B. EATON,

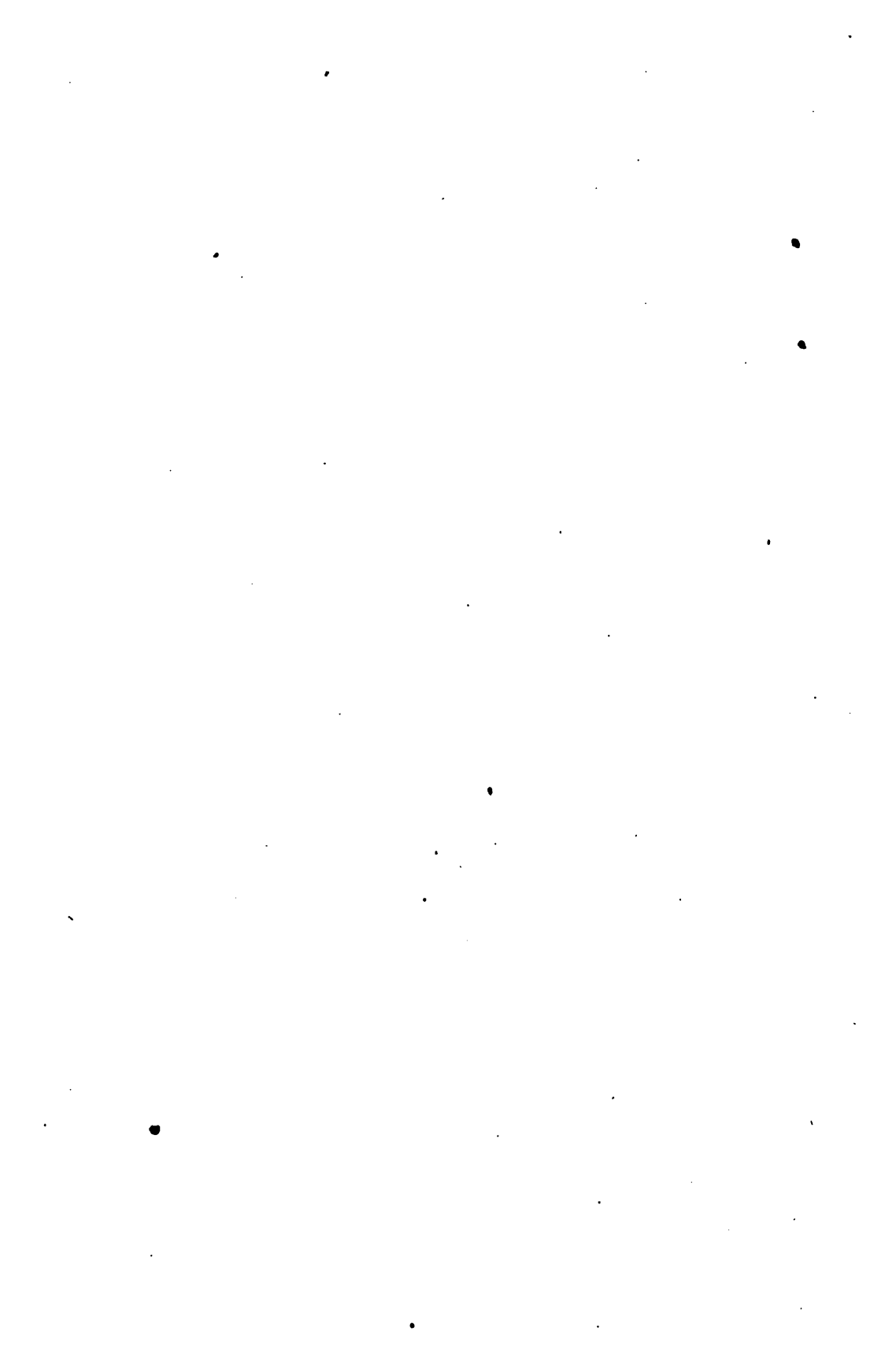
Commissary-General of Subsistence.

Hon. WILLIAM W. BELKNAP,

Secretary of War.



REPORT OF THE SURGEON-GENERAL.



REPORT OF THE SURGEON-GENERAL.

WAR DEPARTMENT, SURGEON-GENERAL'S OFFICE,
Washington, D. C., October 1, 1872.

SIR: I have the honor to submit the following statement of finances and general transactions of the Medical Department of the Army for the fiscal year ended June 30, 1872:

FINANCIAL STATEMENT.

Under the operation of sections 5 and 7 of the act approved July 12, 1870, the financial transactions of the Medical Bureau form a constantly increasing series of separate accounts, which, for the fiscal year ended June 30, 1872, were as follows:

I. Appropriation for the relief of sick and discharged soldiers, under the act approved July 5, 1862:		
Balance unexpended July 1, 1871.....		\$299,802 77
Disbursed during the year.....	\$7,290 73	
Carried to the surplus fund.....	<u>280,597 87</u>	
		<u>287,888 60</u>
Balance June 30, 1872.....		<u>11,914 17</u>
II. Appropriation under act of March 3, 1869, to enable the Secretary of the Treasury to settle the accounts of disbursing officers:		
Balance unexpended July 1, 1871.....		\$80,251 15
Transferred during the year.....		<u>64,400 77</u>
Balance June 30, 1872.....		<u>15,850 38</u>
III. Appropriations for the Medical and Hospital Department of the Army for the time prior to July 1, 1870:		
Balance unexpended July 1, 1871.....	\$1,488,684 28	
Received from sales	16,859 87	
Refunded from appropriation for sick and discharged soldiers	<u>1,345 50</u>	
		\$1,506,889 65
Disbursed during the year.....		<u>258,674 03</u>
Balance June 30, 1872.....		<u>1,248,215 62</u>
IV. Appropriation for the Medical and Hospital Department of the Army for the fiscal year ended June 30, 1871:		
Balance unexpended July 1, 1871.....	\$77,499 50	
Received from sales.....	<u>2,490 31</u>	
		\$79,989 81
Disbursed during the year.....		<u>47,954 62</u>
Balance June 30, 1872.....		<u>32,035 19</u>

V. Appropriation for the Medical and Hospital Department of the Army of the fiscal year ended June 30, 1872:

Appropriated by act of March 3, 1871.....	\$200,000 00	
Received from sales.....	3,114 87	
		\$203,114 87
Disbursed during the year for the current expenses of the Medical and Hospital Department,.....		177,753 66
Balance June 30, 1872.....		25,361 21
Estimated amount necessary to pay for supplies and services contracted for.....		25,361 21

VI. Appropriation for the Army Medical Museum, and Library of the Surgeon-General's Office:

Appropriated by act March 3, 1871.....	\$7,000 00
Disbursed during the year.....	7,000 00

ARTIFICIAL LIMBS.

The number of applications approved during the year for artificial limbs or commutation for the same was as follows:

<i>Commutation.</i>		<i>Limbs in Kind.</i>	
Legs.....	148	Legs.....	75
Feet.....	7	Feet.....	4
Arms.....	219	Arms.....	27
Apparatus.....	132	Apparatus.....	1

HEALTH OF THE ARMY DURING THE FISCAL YEAR ENDED JUNE 30, 1872.

The monthly reports of sick and wounded received during the year represent an annual average mean strength of 24,101 white and 2,494 colored troops.

Among the white troops, the total number of cases of all kinds reported as taken on the sick-list was 47,575, being at the rate of 1,974 per 1,000 of mean strength. (That is very nearly two entries on sick-report during the year for each man.) Of the whole number, 40,265, or 1,671 per 1,000 of strength, were taken on the sick-report for disease, and 7,310, or 303 per 1,000 of strength, for wounds, accidents, and injuries.

The average number constantly on sick-report during the year was 1,217, or 51 per 1,000 of strength; of these, 962, or 40 per 1,000 of strength, were under treatment for disease, and 255, or 11 per 1,000 of strength, for wounds, accidents, and injuries.

The total number of deaths reported was 367, or 15 per 1,000 of mean strength. Of these, 268, or 11 per 1,000 of strength, died of disease, and 99, or 4 per 1,000 of strength, of wounds, accidents, and injuries. The proportion of deaths from all causes to cases treated was 1 death to 130 cases.

Eight hundred and forty-six white soldiers are reported to have been discharged on "surgeon's certificate of disability," being at the rate of 35 per 1,000 of mean strength.

The reports from the colored troops give the following figures, which do not include the white officers:

The total number of cases of all kinds reported was 3,514, or 1,409 per 1,000 of mean strength. Of these, 2,938, or 1,178 per 1,000 of strength, were cases of disease, and 576, or 231 per 1,000 of strength, were wounds, accidents, and injuries.

The average number constantly on the sick-report was 103, or 41 per 1,000; of whom 78, or 31 per 1,000, were under treatment for disease, and 25, or 10 per 1,000, for wounds, accidents and injuries.

The number of deaths from all causes reported was 54, or 22 per 1,000 of strength. Of these 44, or 18 per 1,000 of strength, died of disease, and 10, or 4 per 1,000, of wounds, accidents, and injuries. The proportion of deaths from all causes to cases treated was 1 death to 65 cases.

The number of discharges on "surgeon's certificate of disability" reported was 76, or 30 per 1,000 of mean strength.

WORK PERFORMED IN THE RECORD AND PENSION DIVISION.

The official calls for information from the records filed in the Pension Division have not materially diminished during the fiscal year. It was mentioned in my last annual report that at the close of the previous year, owing to inadequate clerical force, this work was very much behind, hand, 9,244 applications for information, chiefly from the Commissioner of Pensions, remaining on hand unanswered June 30, 1871. The judicious increase in clerical force authorized shortly afterward by the honorable Secretary of War has remedied this difficulty, enabling the division to dispose of this mass of back work as well as to meet current demands for information.

The total number of new applications for information received during the year was 19,237, of which 14,205 were from the Commissioner of Pensions, 4,470 from the Adjutant-General of the Army, and 562 from miscellaneous sources. These new cases, added to the 9,244 back cases on hand at the commencement of the year, made 28,481 to be disposed of.

Search was made and replies furnished to the proper authorities in 23,654 of these cases, viz.: 17,573 to the Commissioner of Pensions, 5,365 to the Adjutant-General of the Army, and 716 to miscellaneous applicants, leaving 4,827 unsearched cases on hand on the 30th of June, 1872. This number had fallen below 3,000 by the middle of September, and it is confidently believed that with the present force the duties of the division can hereafter be performed with reasonable promptness.

As during previous years the applications for information continue to refer chiefly to the cause of death or discharge from service and the hospital history of soldiers dead or disabled during the war of the rebellion. The applications for hospital history have of late become more and more numerous and for some time have constituted the majority of cases acted on. These cases are the most tedious of all to search, it being frequently necessary to trace the patient through the books of many hospitals. It can not therefore be said that there is any immediate prospect of a reduction in the amount of work necessary to be performed in this division.

WORK PERFORMED IN THE DIVISION OF SURGICAL RECORDS.

Ten thousand six hundred and twenty-four cases of wounds and injuries and 404 histories of surgical operations were entered, making a grand total of 246,426 histories at present on the records of this division.

Additional information was entered in 8,325 cases.

The various indices were searched in 35,829 cases and 23,107 new names entered.

The records of the Record and Pension Division were searched for information in 10,841 cases, and the Pension-Office records in 2,303

cases. Eight hundred and sixteen letters and indorsements were written and entered in letter and indorsement-books during the year and 942 letters received. One thousand nine hundred and fifty-two surgical reports were received, examined, and indexed.

ARMY MEDICAL MUSEUM.

Surgical section.

Specimens in museum July 1, 1871.....	5, 922
Specimens in museum July 1, 1872.....	6, 093
Increase.....	171

Medical section.

Specimens in museum July 1, 1871.....	1, 088
Specimens in museum July 1, 1872.....	1, 125
Increase.....	37

Microscopical section.

Specimens in museum July 1, 1871.....	4, 853
Specimens in museum July 1, 1872.....	5, 533
Increase.....	680

Anatomical section.

Specimens in museum July 1, 1871.....	883
Specimens in museum July 1, 1872.....	917
Increase.....	34

Section of comparative anatomy.

Specimens in museum July 1, 1871.....	1, 100
Specimens in museum July 1, 1872.....	*1, 200
Increase.....	100

The total number of specimens added to the museum during the year was 1,022.

The Army Medical Museum continues to receive valuable contributions, which are at once properly prepared, mounted, and their histories entered in the descriptive catalogue. The number of visitors to it during the year was over seventeen thousand, many of whom were in search of information not obtainable in any other quarter. Memoranda and photographs have been furnished to assist in the decision of cases of applicants for the benefits of the various acts of Congress in relation to maimed and disabled soldiers and pensioners; and, as the extent of this collection becomes better known, its usefulness is widely increased, not only by affording opportunities for study to the professional man, but also in promoting the ends of justice in supplying evidence for comparison in criminal trials. The craniological cabinet contains nearly a thousand specimens, including a large number of crania of existing tribes of Indians, a series of skulls from tumuli, and many rare specimens of artificial deformation of the cranium, making it the most complete cabinet of the kind in this country. It has been impossible with the means at my disposal to supply the demand in this country and in

* Of these 295 are complete skeletons of animals and 716 are crania.

Europe for a descriptive catalogue and tabulated measurements of these crania, and I would earnestly renew the recommendation, made in my annual report of 1870,* that the necessary legislation be procured to enable me to publish an edition of one thousand of the catalogue and tables of the anatomical section of the Army Medical Museum in a style similar to Morton's *Crania Americana*.

MEDICAL AND SURGICAL HISTORY OF THE WAR AND OTHER PUBLICATIONS.

The first part of the Medical and Surgical History of the War was in a state of sufficient forwardness to lay before Congress near the close of the last session. By the wording of the act making appropriation for the continuation and completion of this work, its distribution is still to be ordered by Congress.

During the year, Circular No. 3, 1871, being a report of surgical cases treated in the Army of the United States from 1865 to 1871, of three hundred pages, quarto, has been published for distribution.

At the commencement of the fiscal year, the library of the Surgeon-General's Office contained about 14,000 volumes, and a catalogue was printed during the year, making a volume of 454 pages, royal octavo.

Since the scope and character of this library have become known, much interest has been expressed in its progress by physicians throughout the country, and many valuable contributions of old and rare books have been received. It now contains about 19,000 volumes and 7,000 pamphlets, conveniently arranged in the fire-proof building of the Army Medical Museum, and open to the public under regulations essentially the same as those of the Congressional Library.

NUMBER OF MEDICAL OFFICERS, VACANCIES, ETC.

At the date of my last report there existed fifty-four vacancies in the Medical Department, as follows: Chief medical purveyor, one assistant medical purveyor, three surgeons, and forty-nine assistant surgeons. During the past year one assistant medical purveyor has been appointed chief medical purveyor; one surgeon, two assistant surgeons, and one medical store-keeper have died, and one assistant surgeon has resigned, leaving at present fifty-nine vacancies in the corps, viz. Two assistant medical purveyors, four surgeons, fifty-two assistant surgeons, and one medical store-keeper.

The number of military posts July 1, 1872, was 210.

My previous reports have called your attention to the large number of vacancies existing in the medical corps, and the injury to it and the service resulting from the prohibition of appointments and promotions. It would require many years to fill the vacancies now existing, as the number of successful candidates rarely exceeds eight or ten in any one

* The collections now include 897 human crania and 34 skeletons. Elaborate tables have been prepared, exhibiting their measurements. The diameters, facial angle, internal capacity, and position of the *foramen magnum* are indicated for each cranium. It is hoped that the publication of this important contribution to anthropological knowledge will be authorized by Congress. The tables, arranged to correspond with those published in the *Crania Americana* of Samuel George Morton, would worthily supplement that great work. The museum possesses a larger number of skulls from tumuli and of crania of North American Indians than are elsewhere collected, and it would appear due to ethnologists throughout the world that descriptions of the specimens should be published, as was done by the Russian government for the collection of Professor von Bär, at St. Petersburg. — (Annual report of the Surgeon-General for 1870.)

year. This is not the greatest evil, for many of the best of our medical officers, having the advantage of the large experience of the late war, disheartened by the faint prospect of advancement, are resigning, and numbers of most desirable candidates, after waiting years for examination, have established themselves in civil practice. With the Army at its present standard, distributed as it now is, there is a constant and absolute necessity for a medical corps of the full number established by the act of Congress approved July 28, 1866.

J. K. BARNES,

Surgeon-General, United States Army.

The Honorable the SECRETARY OF WAR.

REPORT OF THE PAYMASTER-GENERAL.

20 W



REPORT

OF

THE PAYMASTER-GENERAL.

PAYMASTER-GENERAL'S OFFICE,
Washington, October 10, 1872.

SIR: I have the honor to submit my annual report of the transactions of the Pay Department of the Army for the last fiscal year, ending June 30, 1872. Tabular statements herewith inclosed show in detail the fiscal operations of the Department for that year, summarily stated as follows:

RECEIPTS AND DISBURSEMENTS.

Balance on hand at the beginning of the fiscal year, July 1, 1871...	\$2,684,884 49
Received during the fiscal year from the Treasury	13,392,343 00
Received from other sources	59,092 11
Total	16,136,319 60
Disbursed to the Army, including the Military Academy \$11,764,124 36	
Disbursed to volunteers, and bounties	962,391 29
Total disbursements	12,726,515 65
Refunded to the Treasury	675,929 90
Balance in hands of Paymasters, to be accounted for in next report	2,733,874 05
Total	\$16,136,319 60

RECONSTRUCTION FUND.

Balance in hands of paymasters June 30, 1871	\$723 52
Received from sundry sources	2,417 87
Total	3,141 39
Refunded to Treasury	3,141 39

The most notable events, so far as the Pay Department is concerned, of the last twelve months, are the passage by Congress of the act of 15th May, 1872, "to establish the pay of the enlisted men of the Army," and of the act "to establish a system of deposits," &c. Your last annual report referred to the necessity of action on these subjects.

By the failure of Congress to continue the acts passed during the war increasing the pay of the enlisted men, it had fallen back from \$16 to \$13 per month for the privates. This reduction occurred simultaneously with the abolishing of the deposit system, and the paying back of the deposits by the 30th of June, 1871, and the repayment of clothing-money saved, the combined effect of all being to increase desertion, to dishearten the recruiting service, and depress the enlisted men. But the recent legislation has corrected all these things, and must materially encourage and improve the condition of the rank and file of the Army. The pay-bill

carries the system of "retained pay" to those of all ranks, heretofore confined to the privates. It is deemed important that the non-commissioned officer should also be compelled to save a portion of his pay, and not look, when discharged, with envy upon the private, who had been forced to be more provident. There is every stimulus given for re-enlistment, and the re-enlisted soldier is encouraged by being assured at once of the highest rate of pay. He not only receives the additional pay given by the act of 4th August, 1854, but is placed (if he has ever at any time re-enlisted under that act) upon the maximum rate provided by the act of 15th May, 1872. The recent act provides (like the old system) that the deposit shall not be repaid until the discharge of the soldier, and it adds the important provision, "that for any sums of not less than \$50, so deposited for the period of six months or longer, the soldier, on his final discharge, shall be paid interest at the rate of four per cent. per annum."

In time of peace nine-tenths of the Army are stationed remote from savings banks and all access to the usual modes of investment. In time of war the soldier has most trouble to take care of his money, and the Government is most in want of it. The deposit system fully carried out during the late war would have put millions into the public chest, at a point of time when the Government was most straightened to raise the adequate resources. And no one can doubt the effect of such a system in raising the spirits, stimulating the ambition, and elevating the tone of the enlisted men. If the captains of companies will encourage and persuade their men to make deposits, they will find that it will diminish the number of desertions, and render "pay-day," and the sequel of it, a quiet, orderly event in a garrison—a result which would be a source of great satisfaction to the Pay Department of the Army.

In the month of November, 1872, a system was adopted of comparing the weekly statement of paymasters (giving their balances remaining in the various depositories) with similar statements rendered by each depository to the Treasurer of the United States in this city. If this comparison reveals discrepancies, an explanation is requested. Usually all such discrepancies are accidental, and admit of immediate explanation. But it has been found that otherwise, this system affords information highly important to the Government, and is a very salutary provision. It would have led to the speedy detection of the defalcation of Major Hodge.

I respectfully invite your attention to the importance of Congress repealing the interdict upon promotions and appointments in the Pay Department. Promotion is the life-blood of an army; and this Department is already so reduced, that if any exigency or additional vacancies shall occur, it will be difficult to carry on its business. Two officers being retired during the last year, and two not being reported for duty, the number in certain regions on the frontier, as also in the East, has been diminished. Sickness or temporary disability is likely to occur, especially where the tours of duty performed are so severe. Therefore, a few more paymasters are needed for the absolute wants of the service, without any reference to the propriety of enabling the War Department to give occasional respite and relief to those who are discharging such arduous duties. The vacancies existing (according to the organization established by the act of 28th July, 1866) are one Deputy Paymaster-General and ten paymasters. I recommend that the number of paymasters be established by law at fifty-two. If one paymaster is promoted to Deputy Paymaster-General, there would in that case remain

three vacancies at the foot of the list to be filled, or eight less than by the present organization.

Probably an allusion ought to be here made to the act of 4th June, 1872, but I should not make it if it concerned only myself. It authorized the President to appoint a Paymaster-General to fill the existing vacancy, with the rank, &c., of colonel. The act of 28th of July, 1866, established the rank as brigadier-general; and when the next vacancy occurs it will be filled with that grade, unless the last-named act is changed. The act of 5th June simply permitted the vacancy then existing to be filled. I respectfully submit that the grade should remain that of a brigadier-general. During the war he had charge of more than five hundred paymasters, there being a permanent provision for the expansion of the Pay Department in time of war. Now, two colonels of older date are commanded by myself. This awkward position of affairs would recur in every staff department if such a policy should be carried out, of reducing to colonel the rank of chief of staff whenever a vacancy shall occur. The deliberate action of Congress, after careful consideration of the wants of the Army, led, in 1866, to a gradation of rank in each staff corps, which, I respectfully submit, should not be changed.

As certain schemes for radical changes of organization in the staff have been suggested during the last year, it is proper to call attention to the fact that similar experiments of consolidation have been tried during the last three years in the English service, but are regarded as an utter failure. Witness the proceedings at the meeting of the United Service Institution of England, held on the 5th February, 1872, when E. B. De Fonblanque, deputy controller (retired,) set forth in graphic terms the incongruous elements and inefficient workings of the "control department," as the new system is called. As he had been one of the original advocates for the same, his testimony is the more significant. His criticisms are fully confirmed by papers in Colburn's Naval and Military Journal for November, 1871, and March, 1872; the first describing the "disasters" which had already attended the experiment; the latter speaking of the "collapse of control." At this time, more than at any other, it is natural that we should be led to a close scrutiny of the condition of like branches in foreign armies.

Members of the "control" department were given no military rank, and forcible arguments are advanced by them in favor of such a step, which would increase their prestige when in contact with other branches of the service. This is mentioned as but one example how far advanced we are in our organizations, in which the assimilated rank in the staff involves no collision with the line of the Army, but imparts force and efficiency in the discharge of their duties. Officers of that army, of great intelligence, express unqualified admiration of the successful working on so large a field, of our various staff and supply departments during the late war.

As to the economy of administration, I hope it will not be considered out of place here to recur to the debate in the House of Representatives in April last, between two leading advocates on opposing sides in the question of civil-service reform. Each quoted the statistics of the Pay Department. The one said, "Here is already in existence a system in which, during the late war, the whole expense of administration (including defalcations) was but three-fourths of one per cent. of the total amount disbursed, and in which the defalcations (even if that of Major Hodge is included) were not one-tenth of one per cent. of the same total." The other debater said, "This is true, but it is owing to its being real civil-service reform, viz, an organization independent of politics."

I will add that the result was due (as contrasted with the experience of the war of 1812) to high rank and pay, under a separate organization, being given to the officers of the Pay Department, thus giving every stimulus to good conduct to those who are appointed.

Thus it is respectfully submitted that Congress should not rashly tamper, as some have proposed, with said system, but leave undisturbed an organization of fifty years' growth, which, during that period, has brought honor upon the public service both in time of war and in time of peace.

It is proper that I should add that I have been in charge of this office since the 1st of January, 1872.

Respectfully submitted.

BENJ. ALVORD,
Paymaster-General, United States Army.

The Honorable the SECRETARY OF WAR.

REPORT OF THE CHIEF OF ORDNANCE.



REPORT

OF

THE CHIEF OF ORDNANCE.

WAR DEPARTMENT,
Ordinance Office, October 21, 1872.

SIR: I have the honor to submit the following report of the principal operations of the Ordnance Department during the fiscal year ended June 30, 1872, with such remarks and recommendations as the interests of that branch of the military service seem to require.

The fiscal resources and disbursements of the Department during the year were as follows, viz:

Amount of appropriations in Treasury June 30, 1871.....	\$22,764,295 17
Amount in Government depositories to credit of disbursing officers on same date.....	346,796 52
Amount of deposits in Treasury not reported to the credit of the appropriations.....	706,519 83
Amount of appropriations from July 1, 1871, to June 30, 1872, including the fixed annual appropriation for arming and equipping the militia.....	2,022,804 00
Amount transferred from the Quartermaster's Department from "clothing of the Army" for manufacture of knapsacks, haversacks, canteens, &c.....	20,800 00
Amount received since June 30, 1871, on account of damages to arms in hands of troops, from sales of arms to officers and condemned stores, and from all other sources not before mentioned.....	1,796,868 85
Total	<u>27,658,084 37</u>
Amount of expenditures since June 30, 1871.....	\$1,934,383 31
Amount of expenditures attending auction sales of ordnance stores since June 30, 1871, transporting stores to place of sale and preparing stores yet to be sold	215,558 53
Amount of deposits in Treasury not reported to the credit of the appropriations.....	478,383 86
Amount in Government depositories to credit of disbursing officers June 30, 1872.....	336,958 65
Amount turned into the "surplus fund".....	22,003,491 40
Amount of appropriations in Treasury June 30, 1872.....	*2,689,308 62
Total	<u>27,658,084 37</u>

The operations at the arsenals, with the limited appropriations made by Congress, have been confined to the care and preservation of ordnance and ordnance stores, the manufacture of metallic ammunition and other supplies for the use of the troops, the manufacture and alteration

*Of this sum, \$1,543,965.78 pertain to appropriations prior to July 1, 1870, and can only be used in liquidating liabilities incurred prior to that time, and of the balance \$1,145,041.05 belong to the appropriation for arming and equipping the militia, leaving only the sum of \$301.79 available for the current expenses of the Department for the year.

of iron carriages for our heavy guns that arm the most important of our southern forts, the erection of public buildings at the arsenals where authorized, and the supplying with arms and other ordnance stores the militia of the several States and Territories.

SMALL-ARMS.

At the Springfield armory the operations have been limited to the completion of a few thousand arms necessary to meet the requirements of the Army and militia. At the date of this report, work of every kind at the armory is about ceasing, as a consequence of the following provision in the "act making appropriations for the support of the Army for the year ending June 30, 1873, and for other purposes," approved June 6, 1872:

For manufacture of arms at the national armory one hundred and fifty thousand dollars: *Provided*, That no part of this appropriation shall be expended until a breech-loading system for muskets and carbines shall have been adopted for the military service upon the recommendation of the board to be appointed by the Secretary of War, &c.

Under the provision of this law, a board of five members, of which Brigadier-General A. H. Terry, United States Army, is president, was convened in the city of New York on the 3d September, 1872. The widest publicity was given to the order assembling the board, (hereto appended, marked A,) that all persons interested in breech-loading arms might avail themselves of the opportunity offered to present their inventions for examination and trial. The board is now in session, and until their labors are concluded, and report made, and a "breech-loading system adopted for the military service," this Department is estopped from expending any of the money above appropriated. Should the report of the board be delayed so that the appropriation, or a large portion of it, may revert to the Treasury at the close of the fiscal year, it is recommended that such unexpended balance be re-appropriated in addition to the amount estimated for the ensuing year.

Arms upon the system adopted ought to be manufactured without delay, in quantities sufficient to supply the entire Army with them, and fill requisitions for the militia; and it is earnestly recommended that liberal appropriations may be made to enable this Department to manufacture, from year to year, a sufficient number to accumulate a reserve for the exigencies of war. In the adoption of an arm for the military service, it should be the policy of the Government to determine and fix upon the best arm that can be had for present manufacture, and to be provided in quantities for future emergencies, and retained as the standard arm only so long as none more perfect and efficient as a military weapon has been invented. The object of this Department is, and has been, to secure for the Army and militia the very best military arm that the inventive genius of the age can devise.

REVOLVERS.

Reports from the field are all favorable to the use of revolvers using metallic cartridges, a limited number of which have been heretofore issued to the cavalry service for trial. As soon as certain experiments are completed looking to the improvement of the arm as a military weapon, it is the intention of this Bureau to recommend the manufacture of a sufficient number to meet the requirements of the Army.

NEW EQUIPMENTS.

Since the date of my last annual report the manufacture of knapsacks, canteens, and haversacks for the Army has, upon the recommendation of the Quartermaster-General, and of the board instituted by Special Order No. 433, Adjutant-General's Office, of November 6, 1871, and by your order, been transferred to this Department, which alone has the proper manufacturing facilities in its arsenals. Five thousand sets of infantry equipments have been made and issued to the troops for trial.

These equipments combine the knapsack, haversack, and canteen, with the cartridge-box, waist-belt, and bayonet-scarbald into one system, that can be used by the soldier either in whole or in part, as convenience or necessity may require; and his entire kit in complete marching order can be carried, it is believed, with ease and comfort, and without danger of impairing his health or strength.

An estimate has been made for a sufficient sum to provide the service with these equipments, which it is believed will give satisfaction. The knapsacks on hand, left over from the war, are now worthless and unfit for issue, and will be sold as soon as they can be replaced.

ARMING AND EQUIPPING THE MILITIA.

I have to renew the recommendation of last year that the permanent annual appropriation for arming and equipping the militia be largely increased. The views then expressed are still entertained by me. It is hoped that the bill introduced at the last session from the Committee on the Militia, which was complete in its provisions, may receive the favorable action of Congress during the coming session.

HEAVY ORDNANCE.

Under the following provision of the act of Congress approved June 6, 1872—

For experiments and tests of heavy rifled ordnance, \$270,000: *Provided*, That this appropriation shall be applied to at least three models of heavy ordnance, to be designated by a board of officers, * * * which report shall include both classes, breech and muzzle loading cannon, &c.—

a board of seven officers of different branches of the service was appointed, to meet in New York on the 10th July, 1872. The result of their deliberations are herewith submitted, (marked F.) This Department has taken steps to carry out the recommendations of the board in the procurement and manufacture of these guns deemed most worthy of trial. (See proceedings of board herewith, marked G.) As they are to be of large caliber, for which no suitable powder and projectiles are on hand, as contemplated by the law authorizing the experiments, an estimate for money to provide this essential and expensive necessity for the trial has been submitted.

The procurement and trial of these guns will probably consume all of the year 1873, and no estimate has therefore been made in advance of the probable results, for the manufacture of the successful gun in the quantities now urgently needed for the armament of our forts.

The very moderate estimate made for cannon and carriages for the next fiscal year, it is hoped will be allowed by Congress. This sum can be expended on cast-iron smooth-bore guns, considered the best of the kind in any service, nearly 800 of which, besides 300 mortars, are still needed for our forts. The marked improvement in the manufacture of

our gunpowder seems to indicate that our smooth-bore guns may be used with wonderful battering power, as recent experiments with the 15-inch gun resulted in increased initial velocities, or largely increased working energy, with strains on the gun far within the limits of safety. If such results can be predicated on all future manufactures of gunpowder, then one-half of the difficult problem of our heavy armament is satisfactorily solved.

The accuracy of smooth-bore guns of large caliber, within a mile distance, is fully equal to that of rifled guns, and, in many of our exposed positions within easy range of hostile ships, would be entirely effective. To solve the problem completely, rifled guns with great accuracy at long ranges, and great penetrating power, must be provided, and the results of the experiments authorized by Congress at its last session are looked to with great interest and solicitude.

In previous reports this Bureau has earnestly impressed on Congress the crying demand for cannon in sufficient numbers to complete the armament of our forts, for the defense of our important harbors and largest cities, with their millions of wealth. There appears to be no indisposition on the part of Congress to make large appropriations for the construction of fortifications, not considering the undoubted fact that forts can be readily improvised, at short notice, strong enough to withstand a long siege, as witnessed on more than one occasion during the rebellion, while cannon and carriages are necessarily the work of time, requiring previous preparation, on a large scale, of shops, machinery, skilled labor, and material of a quality to be specially prepared, and not to be found in the markets. Forts, without suitable armaments, are silent monuments of large expenditures without corresponding benefits. They cannot be utilized or defended without the costly guns and carriages that modern science demands, and in war may prove an injury and lead to disaster, by inviting attack without the power of successful defense. Time and money can supply these essential weapons. In war, money alone cannot provide them, and it is only during peace that we can command time in which the money can be judiciously expended.

COMMISSION TO EUROPE.

An invitation having been received from Mr. Fried. Krupp, the most extensive manufacturer of steel cannon in the world, for the presence of some of our officers at the trial of experimental guns of the largest caliber at Essen, Rhenish Russia, I had the honor to recommend an acceptance of the invitation, and that a commission of three ordnance officers be sent to witness the experiments, which recommendation received your approval. It is believed that such an opportunity may not again occur to gather valuable professional information in regard to what are considered by some of the leading military powers of Europe the safest and most efficient heavy ordnance now manufactured. The commission will be ordered to visit such other manufacturing establishments in Europe of heavy guns and kindred projects as their time will permit, that they may be enabled to group together the best results of manufacture and experiments in this respect throughout the continent, and to draw valuable deductions and conclusions for future reference and use.

GUN-CARRIAGES.

One of the difficulties heretofore encountered in using unusually large charges in our guns, was the inability to absorb the recoil within reason-

able distance. This has been satisfactorily overcome by recent experiments with double air-cylinders, fastened to the chassis, the piston-rods attached to the upper carriage. The success has been conclusive in favor of their use, and our carriages are being provided with them as rapidly as the appropriations will permit.

At the suggestion of the Engineer Department, and to give increased protection to the men on the terre-plein of our forts, a carriage higher by fifteen inches than the ordinary pattern has been designed, and tried with satisfactory results. Another device is now being prepared under the direction of this Department, the object of which is to enable the men to elevate and depress, load, point, fire, and manipulate thoroughly our heaviest ordnance with ease, rapidity, and efficiency, and without at all exposing themselves above the parapet.

Should these two devices prove as satisfactory as they promise, their adoption will add greatly to the strength of our defense without diminishing our power of offensive action.

LARGE ARSENAL OF CONSTRUCTION ON THE ATLANTIC COAST, ETC.

I renew the recommendation made in my reports of 1869, 1870, and 1871, for the establishment of a large arsenal of construction and a powder and niter depot at some point on the Atlantic coast; and that authority be requested of Congress to sell such of the arsenals east of the Mississippi River as can be dispensed with and can be disposed of with advantage to the United States, and to apply the proceeds of their sales to the purchase of sites and the erection of buildings. The concentration into one arsenal of all the work now done at several distinct establishments would result in great economy of labor and great perfection of product. It would be but introducing into our Government work the practice that obtains in all private enterprises, and which is being followed by every other first-class power. The network of railroads which covers the land and makes close and rapid communication with the remotest points entirely overcomes the necessity of a half century ago, that demanded an arsenal in almost every State in the Union.

PROVING GROUND.

The necessity for a proving and experimental ground for heavy ordnance has been felt for years, and this Department has been compelled to avail itself of the limited extent of ground near Fort Monroe for the prosecution of these important duties. As the artillery school of practice is established on this reservation, the space is necessarily too contracted for the operations of both. Besides, the range obtained on land is but little more than a mile, and that over the waters of the Chesapeake Bay seldom available, whereas for efficient experimental purposes a range of at least six miles is indispensable.

Some central point convenient to railroad communication, with a suitable extent of level ground, could be readily selected and purchased at small cost. Experiments with large ordnance cannot be properly conducted without the best and most improved facilities, such as every military nation has found it necessary to provide. It is recommended that this important subject be brought to the attention of Congress.

SALE OF HARPER'S FERRY ARMORY.

I referred in my last annual report to the delinquency of the purchasers of the Harper's Ferry property in settling for the lands, &c.,

purchased by them. During the last session of Congress a bill was introduced for the relief of some of these purchasers, but it failed to become a law. The limitation of time for final payment having expired last December, and the purchasers having had the grace of a whole session of Congress for obtaining an extension of time, but without success, I felt it my duty, after the adjournment of Congress, to ask you to place the case of the principal delinquents in the hands of the Department of Justice for legal settlement. Suit has accordingly been entered against them in the United States court of this district, and is now progressing.

SALES OF ARSENALS.

The law for the sale of several of our small arsenals, it is submitted, requires modification. It directs the Secretary of War to sell, after sixty days' advertising, "either by public auction or by inviting proposals for the purchase thereof, and in either case to the highest bidder, all the lands and tenements belonging to the United States" at certain specified places. It may not have been foreseen that if the Secretary should enter upon a sale under this provision he would have no discretion, but must accept the highest bid or offer made. This might lead to a sacrifice of the property through combinations of bidders; and it is recommended that the matter be brought to the attention of Congress in order that the necessary legislation may be taken to guard against such a contingency. A minimum price in each case, it is submitted, might be authorized to be established, below which the property should not be sold, and the Department could then redeem the property from sacrifice by withdrawing it from sale, to be subsequently disposed of under the authority of the Secretary of War, either at public auction, or private sale.

The old arsenal site at Augusta, Georgia, was formally advertised for sale before the defect of the law was discovered, and there being no authority under the law to delay after having begun, the sale has been allowed to proceed.

The act directs the sale of the Apalachicola arsenal at Chattahoochee, Florida. This arsenal was, by act of December 15, 1870, donated to the State of Florida for educational purposes. The provisions of the act which directs its sale should, in my opinion, be repealed.

PERSONNEL.

I have again to renew my recommendation made in the last two annual reports from this Office, that the law of March 3, 1869, prohibiting promotions and appointments in the Ordnance Department be repealed, and I earnestly ask that the subject may be brought to the notice of Congress, and that they may be requested to repeal the law.

The present number of officers in the Ordnance Corps is not sufficient for the proper performance of the duties intrusted to it by Congress.

The act to increase and fix the military establishment of the United States, approved July 28, 1866, gave to the Ordnance Department sixty-four officers and thirteen store-keepers, and the Department was kept up to that number until after the passage of the act approved March 3, 1869, prohibiting promotions and appointments in the staff corps, and which is still in force. Since that time vacancies have occurred which reduce the strength of the Department to fifty officers and eleven store-keepers.

I am of the opinion that the number of ordnance officers (sixty-four),

fixed by the act of July 28, 1866, should not be diminished. That number is needed for the proper and efficient performance of the duties with which it is charged. The officers command the arsenals, armories, and depots, (twenty-eight in number), superintend the manufactures of every kind at the arsenals, requiring in the aggregate a force of 2,500 men, hired and enlisted, the manufacture and proof of all cannon, small arms, and gunpowder for the armies of the United States, and our national militia, and the arming of our fortifications; make all trials and experiments required to perfect our ordnance and other material; have charge of all ordnance stores and other property, valued at over \$50,000,000, and see to its proper care and preservation; and in addition thereto perform the duties of assistant quartermaster and commissary of subsistence for the enlisted force. These duties are sufficient to furnish full employment for the entire number of officers allowed the Department by the act of July 28, 1866.

Ours is the only service in which officers are deprived of all promotion for an indefinite period. Such a course is contrary to all military rule and usage, and is unjust to the officers themselves; and in the matter of appointments very discouraging to graduates of the Military Academy, who look to such an appointment as a reward of merit.

Congress, at its last session, by repealing the act prohibiting appointments and promotions, so far as it related to the Engineer Corps, seems to have admitted that such relief was necessary. It is hoped that similar liberal legislation will be extended to the Ordnance Corps, which is organized in the same manner, having officers of all grades, from brigadier general to second lieutenant, and with duties and responsibilities of no less importance, and demanding equal study, labor, and fidelity.

It is believed that if the attention of Congress is specially called to the necessities of the case, prompt and full relief will be granted, and the distinction, which the law now makes between the two corps, resulting in great hardship to the ordnance, will be at once removed.

THE SPRINGFIELD BREECH-LOADING RIFLE-MUSKET.

In my annual report for last year I had the honor to invite your attention to the subject of royalty claimed on the breech-loading rifle-muskets which have been altered at the Springfield armory. I said:

The conflicting interests of inventors and holders of patents on breech-loading small-arms have seriously embarrassed this Department in the selection of a system for adoption. It appears there are patents (one or more) upon all breech-loading small-arms, and it is not thought that any gun has been made, or can be made by the Government, upon which a claim for royalty will not be made against this Department. I have declined to give an opinion upon the validity of any patent which the Government may have used, or to recommend the allowance of royalty by the War Department on any small-arms which have been made by the Government; and I shall continue to do so, believing that the amount of compensation, and the persons who may be entitled to receive it, should be determined elsewhere than in the War Department.

In my annual report for 1869, I said:

■ "The chief difficulties which this Department had to contend against in producing a good breech-loading musket, have arisen from the impossibility of making any improvement which is not immediately claimed under some one of the many patents which have been granted for improvements in fire-arms, and from the extreme eagerness and strong efforts of some inventors, and all other parties interested in patents, to have their improvements used by the Government. Many persons claim to hold patents for improvements which are used in the conversion of the Springfield muskets; in some instances several parties have claimed to hold patents for the same thing, and it is believed that every improvement is claimed by more than one inventor. The Bureau has declined to acknowledge the validity of any patents for improvements used in the conversion of the Springfield rifled musket, knowing that it was not competent for it

to decide the question, and believing that the proper course for patentees to take was to establish satisfactorily the validity of their claims, and then apply to Congress for compensation for the use of the patents.

"These difficulties have continued to embarrass this Department, and to affect injuriously the interests of the Government; and it is respectfully suggested whether a law may not be devised, which, while affording protection to all inventors in the rights secured to them by patents, will enable the Government to use unrestrictedly any improvement which it may be desirable for it to use. I have no desire to see any inventor deprived of any of his rights, without just compensation; but I am so fully convinced that some law protecting the Government against improper claims of inventors and owners of patents should be passed, that I feel it my duty to bring the matter particularly to your notice, in the hope that something may be done to secure so desirable an end. Such a law would relieve this Department of much annoyance and embarrassment, and would tend, in my opinion, to increase to a considerable degree the efficiency of the public service.

"It is respectfully suggested that a law be passed which will authorize officers in charge of public works to make use of all inventions, or improvements whatever, applicable to the work under their charge; and which will provide that when a claim for damages is made by any person for an invention or improvement so used, at least — days' notice shall be given, requiring all parties claiming said invention or improvement to present their claims, with the evidence in support of the same, to some special tribunal authorized to try the same, whose duty it shall be to decide who is the party entitled to damages or remuneration, and to fix the amount which should be paid by the United States for the use of the invention or improvement; their decision to be final, so far as the United States are concerned; and the amount declared to be due from the United States to be paid out of the appropriation for which the work done is paid."

I repeat this, and earnestly ask that such legislation may be requested of Congress as may be necessary to secure the rights of inventors and owners of patents, and to protect those of the Government and its agents. These latter are not protected now. The commanding officer of Springfield armory and myself have, for more than a year, been subjected to the annoyance of a suit brought against us personally for our official action in having arms made at Springfield armory under the orders of the Secretary of War, and the Government has at the same time been compelled to submit to an expensive lawsuit brought to restrain it from making the arms. Such a state of things ought not to exist.

The suit alluded to terminated in December last, the court rendering the following decision:

This is a suit in equity for alleged infringement of letters-patent of the United States, granted to the complainant as assignee of one James W. Preston, February 5, 1867, for improvement in breech-loading fire-arms.

The defendant, an officer of the United States ordnance, was, by order of the Secretary of War, dated May 3, 1866, assigned to the command of the United States armory at Springfield, Massachusetts, and took command accordingly, and held such command up to the commencement of this suit.

All the breech-loading fire-arms, for making which the defendant is complained of in this suit, were made after May 3, 1866, at the United States armory, Springfield, under the superintendence of the defendant as an officer of the Army, and as such commandant of the armory, and in obedience to specific orders from the Secretary of War, directing the construction of the arms which were made in the specific form as made, according to models furnished by him or by his authority, and so made under the superintendence of the defendant, for use in the military service of the United States.

The case came on for argument at this term. The court are of opinion that the letters-patent of the complainant on which the bill is founded are valid, and that the breech-loading fire-arms made as aforesaid, at the United States armory at Springfield, Massachusetts, infringe the said patent; but they are divided in opinion on the following questions, which arose and were argued, on which questions the opinions of the judges were opposed:

1. Whether the respondent, having made and superintended the making of the said arms, under the circumstances hereinbefore stated, is liable to an injunction as prayed in the bill.

2. Whether the respondent, having so made and superintended the making of the said arms under such circumstances, is liable to an account as prayed in the bill.

Thereupon, at the request of the counsel for both parties, the points upon which the judges were opposed in opinion are stated as above, and the same are hereby certified to the Supreme Court of the United States, in accordance with the provisions of the act of April 29, 1802.

As a consequence a demand has been preferred against the United

States for an allowance of royalty on all arms heretofore altered at the Springfield armory, in which this patent has been used. Besides this special device several others are used in the alteration, which are known to be claimed in existing patents of other parties, and it is the opinion of the Bureau that a settlement, once for all, should be made with all persons interested:

To effect this some tribunal ought to be appointed and empowered to investigate the validity of these latter claims against the Springfield gun, and to settle the total amount to be paid per gun, and the proportional amount thereof due to each inventor; and I earnestly recommend that the matter be pressed upon the attention of Congress at the ensuing session, that this Bureau may, through legislation, be relieved from further embarrassment arising out of the subject.

In addition to the papers heretofore mentioned I submit herewith the following:

B.—Statement of principal articles procured by purchase and by fabrication at the arsenals during the year ended June 30, 1872.

C.—Statement of ordnance and ordnance stores issued to the Regular Army and to posts during the year ended June 30, 1872.

D.—Statement showing the apportionment of arms for the year ended June 30, 1872, under the law of 1808 for arming and equipping the militia, as amended by the seventh section of the act approved March 3, 1855, and regulations established in conformity therewith.

E.—Statement of ordnance and ordnance stores distributed to the militia from July 1, 1871, to June 30, 1872, under the law of 1808, as amended by the seventh section of the act approved March 3, 1855.

I have the honor to be, very respectfully, your obedient servant,

A. B. DYER,

Chief of Ordnance United States Army.

The ADJUTANT-GENERAL UNITED STATES ARMY.

APPENDIX.

A.

[GENERAL ORDERS NO. 58.]

WAR DEPARTMENT, ADJUTANT-GENERAL'S OFFICE,
Washington, June 28, 1872.

The following is an extract from section 1 of the "act making appropriations for the support of the Army for the year ending June 30, 1873, and for other purposes," approved June 6, 1872:

"For manufacture of arms at the national armory, one hundred and fifty thousand dollars: *Provided*, That no part of this appropriation shall be expended until a breech-loading system for muskets and carbines shall have been adopted for the military service upon the recommendation of the board to be appointed by the Secretary of War, which board shall consist of not less than five officers, as follows: one general officer, one ordnance officer, and three officers of the line, one to be taken from the cavalry, one from the infantry, and one from the artillery: *And provided further*, That the system, when so adopted, shall be the only one to be used by the Ordnance Department in the manufacture of muskets and carbines for the military service; and no royalty shall be paid by the Government of the United States for the use of said patent to any of its officers or employes, or for any patent in which said officers or employes may be directly or indirectly interested."

In conformity with the above provisions, a board will assemble in the city of New York on the 3d day of September, 1872, with authority to adjourn to Springfield

armory in order to avail itself of the resources of that establishment, which are hereby placed at its disposal, to consider and recommend for adoption a breech-loading system for muskets and carbines for the military service.

Detail for the board.—Brigadier-General A. H. Terry, United States Army; Colonel P. V. Hagner, Ordnance Department; Colonel H. B. Clitz, Tenth Infantry; Major M. A. Reno, Seventh Cavalry; Captain L. L. Livingston, Third Artillery; Second Lieutenant Henry Metcalf, Ordnance Department, is detailed as recorder of the board.

All persons interested in small-arms are invited to submit samples and appear in person, under such rules as may be adopted by the board.

The Ordnance Bureau will supply such information bearing on the matters under investigation as may be called for by the board.

By order of the Secretary of War:

E. D. TOWNSEND,
Adjutant-General.

B.

Statement of principal articles procured by purchase, and by fabrication at the arsenals, during the year ended June 30, 1872.

23 15-inch Rodman guns.	1,108 rifle-muskets converted from Spencer carbines.
9 carriages for Gatling guns.	13,710 rifle-muskets repaired.
56 breech and muzzle sights.	10,010 rifle-muskets, model 1870.
2 tar-buckets for field-gun.	317 Ward-Burton carbines.
56 cannon-spikes.	20 Springfield carbines.
287 elevating and maneuvering bars.	500 sets cavalry accouterments.
12 fuse-gauges.	500 sets cavalry equipments.
39 gunners' gimlets.	1,000 carbine cartridge-boxes.
78 handspikes, miscellaneous.	53,000 appendages, various.
72 harness-bags.	1,686 saddles covered with leather.
1 ladle and staff for 300-pounder gun.	3,676 side-lines, lariats, picket-pins, &c.
152 priming-wires.	15,807 cartridge bags filled, for field and fortress guns.
45 rammers and staves.	37,947 cartridge bags, empty.
8 worms and staves.	3,718,701 metallic cartridges for small-arms.
19 shell-hooks.	650 cartridge-shells.
48 cannon-scrapers.	25,570 friction-primers.
17 sponge-covers.	90 metallic fuses.
24 sponges and rammers.	265,650 lead bullets.
25 sponges and staves.	223 pulley-blocks.
9 woolen sponges.	2 derricks.
2 tangent scales.	1 gin.
19 paulins, 12 by 15.	7 gin-falls.
36 tompons for heavy guns.	19 cranes.
6 tube-ponches.	40 chocks.
132 vent-covers.	160 skids, rollers.
9 vent-punches.	8 sling-carts.
28 wipers for mortars.	6 platforms for siege-carriages.
378 feed-cases for Gatling guns.	2 plane-tables.
20 12-pounder shot.	140 various parts of gun-carriages.
50 8-inch canister, fixed.	18 staves for siege-guns.
200 3-inch Hotchkiss shells.	47 sabots.
120 3-inch Hotchkiss case shot.	70,739 parts of small-arms.
80 3-inch Hotchkiss canister.	4,398 parts of horse-equipments.
2 experimental muskets, caliber .40.	282 arm-chests.
1 Remington navy rifle.	5,981 packing-boxes.
5 Remington rifle-muskets.	93 tin cans.
1,015 Ward-Burton rifle-muskets.	4 machines for loading, &c., metallic cartridges.
199 Springfield rifle-muskets repaired.	
1,557 Springfield rifle-muskets, cadet, model 1869.	
3,569 Spencer carbines repaired.	

C.

Statement of ordnance and ordnance stores issued to the Regular Army, and to posts, during the year ended June 30, 1872.

CLASS 1.

2 6-pounder bronze guns.	13 15-inch Rodman guns.
12 12-pounder light bronze guns.	24 100-pounder Parrott guns.
3 12-pounder mountain howitzers.	32 200-pounder Parrott guns.
1 12-pounder boat howitzer.	6 300-pounder Parrott guns.
4 10-pounder Parrott guns, iron.	8 13-inch sea-coast mortars, (Rodman.)
10 3-inch wrought-iron guns.	17 Gatling guns, $\frac{1}{2}$ and 1.
8 10-inch Rodman guns.	

CLASS 2.

12 3-inch 6 and 10 pounder gun-carriages.	17 $\frac{1}{2}$ and 1 Gatling-gun carriages.
17 12-pounder light gun-carriages.	18 13-inch mortar-beds, (Rodman.)
3 12-pounder mountain howitzer carriages.	8 3-inch, 6 and 10 pounder caissons.
1 12-pounder boat howitzer slide, wood.	7 12-pounder field-gun caissons.
8 100-pounder Parrott carriages and chassis.	2 12-pounder mountain-howitzer caissons.
12 200-pounder Parrott carriages and chassis.	15 $\frac{1}{2}$ and 1 Gatling-gun caissons.
1 10-inch barbette carriage and chassis, with air-cylinders.	1 traveling forge.
	1 battery wagon.
	1 portable forge.

CLASS 3.

50 sets of field-artillery harness for 2-wheel horses.	95 sets of field-artillery harness for 2-lead horses.
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CLASS 4.

360 4.5-inch shot, Hotchkiss patent.	2,000 100-pounder canister, Parrott patent.
200 3-inch shell, Hotchkiss patent.	2,200 200-pounder case-shot, Parrott patent.
120 3-inch case-shot, Hotchkiss patent.	5 32-pounder Parrott shell.
80 3-inch canister, Hotchkiss patent.	5 42-pounder Parrott shell.
260 30-pounder shot, Parrott patent.	17 10-inch Columbiad shell.
100 30-pounder shell, Parrott patent.	22 8-inch Columbiad shell.
100 30-pounder case-shot, Parrott patent.	200 8-inch siege-shell.
2,100 100-pounder shot, Parrott patent.	200 10-inch siege-shell.
3,000 100-pounder shell, Parrott patent.	100 3-inch Absterdam shot.
2,700 200-pounder shot, Parrott patent.	100 4.5-inch Absterdam shell.
3,050 200-pounder shell, Parrott patent.	60 3-inch Eureka shell.
123 300-pounder shot, Parrott patent.	100 3-inch Eureka case-shot.
500 300-pounder shell, Parrott patent.	100 8-inch siege-mortar shell.
2,000 100-pounder case-shot, Parrott patent.	587 13-inch sea-coast mortar shell.
	400 15-inch shot, (Rodman.)
	917 15-inch shell, (Rodman.)

CLASS 5.

196 12-pounder shot, strapped and fixed.	116 12-pounder mountain-howitzer canister, strapped and fixed.
346 12-pounder shells, strapped and fixed.	268 3-inch Hotchkiss shot, strapped and fixed.
350 12-pounder spherical case-shot, strapped and fixed.	1,043 3-inch Hotchkiss shell, strapped and fixed.
200 12-pounder canister, strapped and fixed.	699 3-inch Hotchkiss case-shot.
86 12-pounder field-howitzer shell, strapped and fixed.	696 3-inch Hotchkiss canister, strapped and fixed.
113 12-pounder field-howitzer case-shot, strapped and fixed.	50 30-pounder Parrott canister, strapped and fixed.
61 12-pounder field-howitzer canister, strapped and fixed.	50 8-inch siege-howitzer canister, strapped and fixed.
116 12-pounder mountain-howitzer shells, strapped and fixed.	100 10-inch Columbiad or Rodman, grape.
865 12-pounder mountain-howitzer case-shot, strapped and fixed.	

CLASS 6.

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| <p>3, 192 Sharp's carbines, caliber .50.
 250 Sharp's carbines, experimental, caliber .50, 1870.
 206 Remington carbines, experimental, caliber .50, 1870.
 207 Springfield carbines, experimental, caliber .50, 1870.
 612 Spencer carbines, caliber .50.
 445 Spencer carbines, caliber .50, with Stables's attachment.
 211 Ward-Burton carbines, experimental, caliber .50, 1871.
 1, 211 Springfield breech-loading rifle-muskets, caliber .50, 1868.
 Springfield breech-loading rifle-muskets, caliber .50, 1870
 243 Springfield breech-loading rifle-muskets, experimental, caliber .50, 1870.</p> | <p>245 Remington breech-loading rifle-muskets, experimental, caliber .50, 1870.
 302 Sharp's breech-loading rifle-muskets, experimental, caliber .50, 1870.
 947 Ward-Burton breech-loading rifle-muskets, experimental, caliber .50, 1871.
 1, 432 Colt's revolvers, caliber .44.
 1, 957 Remington revolvers, caliber .44.
 377 Smith & Wesson revolvers, caliber .44.
 99 Smith & Wesson revolvers, nickel-plated, caliber .44.
 50 Colt's, caliber .36.
 17 sabers, artillery.
 1, 605 sabers, cavalry.
 146 swords, musicians'.
 152 swords, non-commissioned officers'.
 12 sabers, cavalry, nickel-plated.</p> |
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CLASS 7.

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| <p>2, 867 carbine cartridge-boxes.
 584 carbine cartridge-pouches, with slings and slides.
 3, 032 carbine slings.
 2, 834 carbine sling-swivels.
 3, 977 pistol-belt holsters.
 2, 439 pistol cartridge-pouches.
 2, 795 saber belts.
 3, 377 saber belt-plates.
 1, 685 saber knots.
 980 Stewart's saber attachments.
 60 accouterments, sets of, for infantry.
 5, 379 bayonet scabbards.
 489 bayonet-scabbards, with Hoffman's attachment.
 215 bayonet-scabbards for trowel-bayonets.
 5, 333 cartridge-boxes, caliber .58.
 963 cartridge-boxes, various patterns.
 1, 944 cartridge-box plates.
 3, 187 cartridge-box belts.
 1, 818 cartridge-box belt-plates.
 4, 543 gun-slings.
 75 sword belts, for musicians and non-commissioned officers.
 64 sword-belt plates.</p> | <p>391 waist-belts, non-commissioned officers'.
 327 waist-belt plates, non-commissioned officers'.
 5, 494 waist-belts, privates'.
 2, 375 waist-belt plates, privates'.
 3, 139 bridles, curb.
 2, 994 bridles, watering.
 8, 699 curry-combs.
 954 girths.
 4, 415 halters and straps.
 9, 877 horse-brushes.
 7, 594 lariats.
 4, 969 nose-bags.
 3, 847 picket-pins.
 3, 701 saddles.
 2, 065 saddle-bags.
 359 saddle-blankets, red.
 7, 420 saddle-blankets, blue.
 6, 581 spurs and straps.
 2, 327 surcingle.
 4, 581 canteens.
 5, 597 haversacks.
 4, 897 knapsacks.
 980 great-coat straps.
 400 knapsack-straps.
 1, 071 canteen-straps.</p> |
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CLASS 8.

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| <p>330, 541 Spencer carbine-cartridges, caliber .50.
 4, 016 Spencer carbine-cartridges, caliber .52.
 5, 000 Spencer carbine-cartridges, blank, caliber .50.
 10, 000 Martin carbine-cartridges, center-fire, caliber .50.
 60, 000 center priming carbine-cartridges, caliber .50.
 18, 000 round ball musket-cartridges, caliber .69.
 1, 278, 505 United States center-fire musket-cartridges, caliber .50.
 221, 668 United States center-fire musket-cartridges, blank, caliber .50.
 226, 980 Martin metallic musket-cartridges, caliber .50.
 161, 880 wrapped metallic musket-cartridges, caliber .50.</p> | <p>317, 114 Colt's and Remington pistol-cartridges, caliber .44.
 219, 880 center-fire pistol-cartridges, caliber .44.
 11, 650 center-fire pistol-cartridges, blank, caliber .44.
 130, 088 Martin pistol-cartridges for Smith & Wesson, caliber .44.
 5, 000 pistol-cartridges, caliber .36.
 6, 000 center-fire cartridges for Gatlin gun, caliber .1.
 4, 000 center-fire canister for Gatlin gun, caliber .1.
 8, 400 pounds cannon-powder.
 14, 000 pounds mortar-powder.
 50, 192 pounds mammoth-powder.
 200 pounds musket and rifle powder.
 108, 569 friction-primers.</p> |
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D.

Apportionment of arms for the year ended June 30, 1872, under the law of 1808, for arming and equipping the militia, as amended by the seventh section of the act approved March 3, 1855, and regulations established in conformity therewith.

States and Territories.	Number of representatives and senators.	Money-value.	States and Territories.	Number of representatives and senators.	Money-value.
Alabama	8	\$4,380 29	Oregon	3	\$1,642 61
Arkansas	5	2,737 68	Pennsylvania	23	14,235 94
California	5	2,737 68	Rhode Island	4	2,190 14
Connecticut	6	3,285 21	South Carolina	6	3,285 21
Delaware	3	1,642 61	Tennessee	10	5,475 36
Florida	3	1,642 61	Texas	6	3,285 21
Georgia	9	4,927 82	Vermont	5	2,737 68
Illinois	16	8,760 58	Virginia	10	5,475 36
Indiana	13	7,117 97	West Virginia	5	2,737 68
Iowa	8	4,380 29	Wisconsin	8	4,380 29
Kansas	3	1,642 61		317	
Kentucky	11	6,092 89			
Louisiana	7	3,832 75	Arizona Territory		1,642 61
Maine	7	3,832 75	Colorado		1,642 61
Maryland	7	3,832 75	Dakota Territory		1,642 61
Massachusetts	12	6,570 44	Idaho Territory		1,642 61
Michigan	8	4,380 29	New Mexico Territory		1,642 61
Minnesota	4	2,190 14	Montana Territory		1,642 61
Mississippi	7	3,832 75	Utah Territory		1,642 61
Missouri	11	6,092 89	Washington Territory		1,642 61
Nebraska	3	1,642 61	Wyoming Territory		1,642 61
Nevada	3	1,642 61	District of Columbia		1,642 61
New Hampshire	5	2,737 68	Total		189,995 00
New Jersey	7	3,832 75	Freight, &c		11,005 00
New York	33	18,068 69			
North Carolina	9	4,927 82			
Ohio	21	11,498 26			200,000 00

E.

Statement of ordnance and ordnance stores distributed to the militia from July 1, 1871, to June 30, 1872, under the law of 1808, as amended by the seventh section of the act approved March 3, 1855.

2 3-inch wrought-iron guns.	2,364 sets infantry accouterments.
1 6-pounder bronze gun.	241 non-commissioned officers' swords.
2 12-pounder bronze guns.	3,336 waist-belts.
2 3-inch gun-carriages.	2,336 waist-belt plates.
1 6-pounder gun-carriage.	1,000 gun-slings.
2 12-pounder gun-carriages.	100 carbine-slings.
2 caissons.	100 carbine-swivels.
5,669 breech-loading rifle-muskets, caliber .50, with appendages.	1,000 cartridge-boxes.
2,144 rifle-muskets, caliber .58, with appendages.	300 carbine cartridge-boxes.
180 Spencer carbines.	1,200 bayonet-scabbards.
24 Remington revolvers.	200 tumbler-screws.
50 sets horse-equipments.	50 tang-screws.
335 sabers, cavalry and artillery.	3,500 friction primers.
295 saber belts and plates.	200 12-pounder blank cartridges.
40 sets cavalry accouterments.	430 shot and shells.
	500 pounds powder.
	388,000 cartridges for small-arms.

F:

PROCEEDINGS AND RECOMMENDATIONS OF THE BOARD ON HEAVY RIFLED ORDNANCE, INSTITUTED UNDER THE ACT OF JUNE 6, 1872, FOR THE SELECTION OF BREECH-LOADING AND MUZZLE-LOADING RIFLED ORDNANCE FOR EXPERIMENTS AND TESTS.

NEW YORK CITY, *August 27, 1872.*

GENERAL: I have the honor herewith to transmit the proceedings and recommendations of a board on heavy ordnance, convened in this city by virtue of general orders No. 57, dated War Department, Adjutant General's Office, Washington, June 20, 1872.

The board suggests that the reports furnished by the Navy Department for its use be not printed without the consent of that Department.

I am, sir, yours respectfully,

R. H. K. WHITELEY,
Colonel of Ordnance.

Brigadier-General A. B. DYER,
Chief of Ordnance, Washington City.

PROCEEDINGS OF THE BOARD ON HEAVY CANNON.

A board was convened at New York City, July 10, 1872, by the following order:

[General Orders No. 57.]

"WAR DEPARTMENT, ADJUTANT-GENERAL'S OFFICE,
" *Washington, June 28, 1872.*

"A board, to consist of Colonel R. H. K. Whiteley, Ordnance Department; Colonel George W. Getty, Third Artillery; Lieutenant-Colonel H. G. Wright, Corps of Engineers; Lieutenant-Colonel T. T. S. Laidly, Ordnance Department; Major Truman Seymour, Fifth Artillery; Major Silas Crispin, Ordnance Department; First Lieutenant C. E. Dutton, Ordnance Department, is hereby appointed to meet in New York City, New York, on the 10th day of July, 1872, for the purpose of examining such models of heavy ordnance as may be presented to it, and of designating and reporting to the Chief of Ordnance such models as may be selected for experiments under the following provision of the act of Congress approved June 6, 1872.

"That the following sums be, and the same are hereby, appropriated, out of any moneys in the Treasury not otherwise appropriated, for the support of the Army for the year ending June thirtieth, eighteen hundred and seventy-three:

"For experiments and tests of heavy rifled ordnance, two hundred and seventy thousand dollars: *Provided*, That this appropriation shall be applied to at least three models of heavy ordnance, to be designated by a board of officers to be appointed by the Secretary of War, which report shall include both classes, breech and muzzle loading cannon; and the powder and projectiles necessary for testing the same shall be supplied from stores on hand.

"The Chief of Ordnance will supply the board with all information bearing on the subject under consideration to be found on the files of his bureau, and will extend invitations to all inventors and others interested in heavy rifled ordnance, to present their plans and specifications as to model, method of construction, cost, &c., and all other information that may be of assistance to the board. The junior member of the board will act as recorder.

"By order of the Secretary of War.

"E. D. TOWNSEND,
" *Adjutant-General.*

"Official:

"WM. D. WHIPPLE,
" *Assistant Adjutant-General.*"

Pursuant to the foregoing order the board assembled at the Army Building, New York City, at 11 o'clock on the 10th day of July, 1872, all the members specified in the foregoing order being present.

A letter to the board from B. F. Mann, of Pittsburgh, Pennsylvania, relating to his plan for the construction of heavy breech-loading cannon, was read and placed on file. (Indorsed No. 1.)

A letter from Norman Wiard to Major S. Crispin, and submitted by Major Crispin to the board, was read. This letter transmitted a paper containing a proposition to con-

struct a 12-inch cast-iron rifle, and to furnish projectiles; which paper was also read. It also transmitted a printed letter to the Secretary of the Navy, with photographic illustrations, explanatory of his views and the details of his proposition. (Letter indorsed No. 2, and inclosures indorsed No. 2 *a*, and No. 2 *b*.)

A letter from the Chief of Ordnance was read, transmitting copies of ordnance memoranda Nos. 9 and 10; papers explanatory of inventions by numerous persons; a communication of Major S. Crispin, on the subject of sea-coast armament; a list of persons who have been furnished with a copy of the order convening this board, and a letter of Major-General A. De Gorloff; and informing the board of his readiness to furnish it with all information which it may desire and which may be in his possession. (Filed. Indorsed No. 3, and inclosures marked No. 3 *a* to No. 3 *r*, inclusive.)

A telegram was read from J. B. Moody, of Cincinnati, Ohio, asking permission to lay before the board his plan for the construction of breech-loading cannon. (Filed. Indorsed No. 4.)

Dr. W. E. Woodbridge being present, explained his plan for the construction of cannon, and was invited to submit his plans in writing.

William W. Hubbell, being present, explained three plans for the construction of heavy cannon. He submitted a written explanation of his plans, which was filed. (Indorsed No. 5.)

A letter from Treadwell Cleveland was read, submitting in behalf of Edward L. Brown and himself a plan for the construction of heavy cannon. (Filed. Indorsed No. 6, with inclosure No. 6 *a*.)

E. B. Brown, of Rhode Island, appeared before the board in person and exhibited and explained a model for a breech-loading gun and carriage. This design being obviously applicable only to movable guns of small caliber, it was decided that it did not come within the purview of the board.

The board then adjourned at 3 o'clock p. m. until 11 o'clock a. m. of the 11th instant.

NEW YORK, *July 11, 1872.*

The board met, pursuant to adjournment, at 11 o'clock, all the members being present.

A letter of Hermann Boker & Co., agents of the Bochum Mining and Manufacturing Company, to Major S. Crispin, and submitted by Major S. Crispin to the board, was read, stating that their agent in London had been telegraphed to procure from B. F. Stevens, United States dispatch agent, a set of English official publications relative to ordnance material. (Filed. Indorsed No. 7.)

A letter from Hermann Boker & Co. was submitted by Major S. Crispin, giving information relating to the lining of cast-iron guns with steel tubes. (Filed. Indorsed No. 8.)

A letter to the Chief of Ordnance, from W. H. H. Terrell, of the Post-Office Department, was read, asking that the plan of his brother, John A. Terrell, be considered by the board. (Filed. Indorsed No. 3 *c*.)

A document, with a model explanatory of Mr. Terrell's plan, was laid before the board, and ordered to be filed. (Indorsed No. 9.)

A copy of the specification of the patent of L. W. Wright, illustrated by drawings, for the construction of heavy cannon, was read and filed. (Indorsed No. 11.)

A letter of William Fields, of Wilmington, Delaware, was read, explaining his plan for the construction of projectiles and the use of a new gunpowder. A model of his projectile was also before the board. (Filed. Indorsed No. 9.)

A telegram of H. J. Allen, of Arkadelphia, Arkansas, was read, calling attention to his plan for the construction of cannon, and inquiring if his presence is necessary. A letter of H. J. Allen to the Chief of Ordnance, explaining his plan, and transmitted by the Chief of Ordnance by Doc. No. 3, was read. The telegram was filed, (indorsed No. 10,) and the recorder directed to telegraph to Mr. Allen that his plan was before the board and his presence optional but not necessary. (Letter-book No. 5.)

Charles W. Moody, being present, explained to the board the plan of his father, John B. Moody, for constructing breech-loading cannon.

Norman Wiard being present, explained to the board the plans and views already submitted by him, and was invited to submit further explanations.

John A. Terrell being present, explained his plan, and asked permission to withdraw his document from the files, in order to condense it, which was permitted.

L. W. Wright, of Brooklyn, New York, being present, explained his plan, which was already before the board.

The board here adjourned until half past 10 o'clock of the 12th instant.

NEW YORK, *July 12, 1872.*

The board met, pursuant to adjournment, at half-past 10 o'clock a. m., all the members being present.

A letter was read from Alex. T. Loyd, of Chicago, Illinois, asking for the consideration of his plan, and placed on file. (Indorsed No. 12.)

A letter from William Fields, of Wilmington, Delaware, was read, notifying the board that a package containing models and other material had been sent. The recorder was directed to acknowledge the receipt of the package. (Letter filed. Indorsed No. 13.)

A letter from James F. Hall was read, calling attention to the invention of James A. Ball, of Cold Spring, New York, and requesting permission to lay it before the board. (Filed, and indorsed No. 14.)

A letter from Major J. G. Benton, commanding Springfield Armory, was read, in reply to letter No. 5, stating that no pieces of Dr. W. E. Woodbridge's gun were at Springfield Armory. (Filed, indorsed No. 15.)

A letter from Charles W. Moody was read, further explaining the plan of his father, John B. Moody, which plan is already before the board. (Filed. Indorsed No. 16.)

A letter from Hermann Boker & Co. was read, stating the ability of the Bochum Mining and Manufacturing Company to furnish a 12-inch rifle within one year. (Filed. Indorsed No. 17.)

A letter from Thomas Prosser & Son was read, giving information and references respecting the Krupp guns. (Indorsed No. 18.)

Alban C. Stimers being present, informed the board of the Lyman Multicharge gun, and requested permission to lay before the board plans and other matter relating to it, which was granted.

James F. Hall, in behalf of James A. Ball, being present, submitted a drawing of a muzzle-loading gun and a model of a breech-loading gun, and requested permission to be heard again, which was granted. (Models filed. Indorsed No. 23.) [Paper and drawing subsequently withdrawn.]

Daniel Fitzgerald being present, explained his plan for constructing guns, and exhibited a model. He also submitted his letters-patent. His letter of July 11 was placed on file. (Indorsed No. 19.)

Nathan Thompson being present, submitted a proposition to construct two guns, which was read and filed. (Indorsed No. 20.) He requested permission to be heard again, which was granted.

The recorder was directed to write to the Chief of Ordnance, asking that the Department furnish information respecting the Lyman Multicharge gun, and a letter correcting an error of letter No. 6, in the name of John B. Moody.

The board then adjourned till 10.30 a. m. of the 13th instant.

NEW YORK, July 13, 1872.

The board assembled at 10.30 a. m., pursuant to adjournment, all the members being present.

It was resolved that the Chief of Ordnance be requested to furnish the board with information giving the numbers and calibers of serviceable sea-coast guns on hand, including those in service. Also that the Adjutant-General be requested to obtain from the Chief of Engineers information as to the number and calibers of sea-coast guns required to arm permanent positions, now completed, in process of construction, and projected. Also that vols. v, vi, and vii, of the "Minutes of the proceedings of the Royal Artillery Institution," now in the Library of Congress, be obtained for the use of the board. Also that the Chief of Ordnance be requested to furnish drawings of the Swedish breech-loading gun and Vasseur muzzle-loading gun.

Mr. John A. Terrell being present, explained the plan already submitted by him, and returned the document withdrawn by him on July 11. (No. 21.)

The board then adjourned till 12 m. July 15.

NEW YORK, July 15, 1872.

The board assembled, pursuant to adjournment, at 12 m., all the members being present.

The indorsement of the Chief of Ordnance upon letter No. 8 was read, transmitting the report on the trial of a steel cylinder, called for by that letter. (Indorsed No. 22.)

A letter from E. Wiler Dunlop, of Trenton, New Jersey, asking for information, was read and filed. (Indorsed No. 24.) The recorder was instructed to reply. (Letter-book No. 14.)

A paper from James A. Ball was read, setting forth the merits and advantages of his projectile. (Filed. Indorsed No. 23.)

James A. Ball being present, explained at length the ideas involved in his invention of a projectile and of a breech-loading cannon, both of which were already before the board. He was requested to put his views and explanations in writing, and for that purpose was allowed to withdraw his paper, No. 23, for further elucidation.

The recorder was instructed to write to W. E. Woodbridge and to Norman Wiard, inquiring when they would be ready to present their additional explanations to the board. (Letter-book Nos. 15 and 16.)

The board then adjourned to 10.30 a. m. of the 16th instant.

NEW YORK, July 16, 1872.

The board assembled at 10.30 a. m., pursuant to adjournment, all the members being present.

The indorsements of the Adjutant-General and the Chief of Ordnance upon the letters of D. K. Swisher, of Union City, Indiana, were read. The letters themselves were also read, and the recorder instructed to inform Mr. Swisher that his plan being for small guns alone, did not come within the purview of the board. (Filed and indorsed No. 25. Letter-book No. 21.)

It was decided to request the Chief of Ordnance to furnish the board with the records of firing, &c., of 12-inch and 8-inch Rodman rifles. (Letter-book No. 17.)

The recorder was instructed to write to Messrs. Cooper & Hewitt, asking for information respecting the cost of manufacturing steel wire of three-tenths inch square gauge, in large quantities, and whether any experiments had been made by them to ascertain how its properties were affected by the prolonged action of heat. (Letter-book No. 18.)

A letter of Alexander T. Loyd, of Chicago, Illinois, was read, transmitting a paper explaining a new projectile. The paper was also read. (Filed. Indorsed No. 26.)

A letter from W. W. Hubbell, of Philadelphia, Pennsylvania, was read, transmitting a further plan and copies of his letters-patent; also explaining their operation. (Filed. Indorsed No. 27.)

Norman Wiard's brochure, containing a printed letter to the Secretary of the Navy and other matters, was read in full and discussed. (Doc. No. 2, b.)

The board then adjourned to 10.30 a. m. of the 17th instant.

NEW YORK, July 17, 1872.

The board assembled at 10.30 a. m., pursuant to adjournment, all the members being present.

A letter from Jacob Reese, of Pittsburgh, Pennsylvania, was read, submitting a plan for constructing a gun with a tube from crucible steel and a body of Bessemer steel or gun-metal, (cast iron.) (Filed. Indorsed No. 28.)

The recorder was instructed to write to Mr. Reese, and inquire whether he can construct with a core of cast steel and a jacket of Bessemer steel, in the manner he proposes in his letter of June 6, a rifle of 12-inch bore, weighing 50,000 to 70,000 pounds, throwing a projectile of not less than 600 pounds, with a charge of 80 pounds of powder, and, if so, that he prepare the specifications for such rifle, with data as to cost, and present the same to the board as soon as practicable. (Letter-book No. 22.)

Alonzo Hitchcock being present, explained his proposed method of constructing heavy cannon of Bessemer steel or wrought iron, and submitted drawings and documents, which he subsequently withdrew for the purpose of putting them into more systematic form. His letter of transmittal was filed. (Indorsed No. 30.)

Henry Durell being present, explained his plan for constructing cannon, and exhibited models. His memorandum was filed. (Indorsed No. 29.)

A letter from Clifford Arrick was read, offering for trial a wrought-iron 6.4-inch gun, with a steel core, and asking permission to lay before the board his plan for shooting guns of every caliber. (Filed. Indorsed No. 31.)

The recorder was instructed to inform Mr. Arrick that the board does not regard a 6.4-inch gun as classifiable with *heavy* rifled cannon, within the meaning of General Orders No. 57, and therefore his proposition respecting three 6.4-inch rifles does not come within the purview of the board; if, however, he has any plans to submit for the construction of similar guns of ten and twelve inches caliber, the board would be pleased to receive them, with estimate of costs and any other information he may be able to give concerning them, and this as soon as practicable; that the subject of projectiles *per se* does not properly come before the board, but only as an essential feature of some system of gun-construction. (Letter-book No. 24.)

The indorsement of the Chief of Ordnance upon letter No. 12 was read, giving the information called for by that letter as to the numbers and calibers of sea-coast guns on hand; also transmitting drawings of the twenty-four centimeter breech-loading Swedish gun and the Vavasseur steel gun. (Filed. Indorsed No. 32.)

The letter of A. W. Kercheval, of Romney, West Virginia, to the Adjutant-General, was read, referring to previous communications from him explaining his section battery. (Filed. Indorsed No. 33.)

The letters of A. W. Kercheval, of February 2 and 21, 1872, transmitted by the Chief of Ordnance, were read, and the recorder was instructed to inform Mr. Kercheval that the plan proposed by him, being for small cannon, did not come within the purview of the board. (Letter-book No. 23.)

A letter from Charles Alger, of Frostburgh, Maryland, to the Secretary of War, was read, asking for the consideration of his plan for a breech-loading gun; also a copy of the report of Captain S. V. Benét to General J. W. Ripley, Chief of Ordnance, upon the trial of Mr. Alger's gun in 1861. (Filed. Indorsed No. 34.)

The board here adjourned to 10.30 a. m. of the 18th instant.

NEW YORK, *July 18, 1872.*

The board assembled at 10.30 a. m., pursuant to adjournment, all the members being present.

The recorder was directed to write to Mr. Charles Alger, of Frostburgh, Maryland, inquiring if he can make a twelve-inch rifle, on the plan proposed by him, and, if so, requesting him to submit plans, with estimate of cost. (Letter-book No. 27.)

The following resolution was submitted by Lieutenant C. E. Dutton:

Resolved, That the board proceed to determine what calibers and natures of guns come within the meaning of the order convening the board. It was moved and carried that the resolution be laid upon the table.

AYES—Colonel Whiteley, Colonel Getty, Lieutenant-Colonel Wright, Lieutenant-Colonel Laidley, and Major Seymour—5.

NOES—Major Crispin and Lieutenant Dutton—2.

The following resolution was offered by Lieutenant Dutton.

Resolved, That the board will not recommend for trial any gun which is constructed on a plan which does not offer reasonable ground for the belief in the probability that the same mode of construction is applicable to the construction of a twelve-inch rifle. It was moved and carried to lay the resolution on the table.

AYES—Colonel Whiteley, Colonel Getty, Lieutenant-Colonel Wright, Lieutenant-Colonel Laidley, and Major Seymour—5.

NOES—Major Crispin and Lieutenant Dutton—2.

A letter of the Chief of Ordnance was read, transmitting information respecting 8-inch and 12-inch Rodman rifles. (Filed. Indorsed No. 36.)

Nathan Thompson having appointed to confer with the board on this day, Mr. Jennings appeared in his behalf, and read a letter from Mr. Thompson, explaining that he was prevented from fulfilling the appointment by reason of illness in his family. It was decided to hear Mr. Thompson on the 22d instant.

A letter from W. E. Woodbridge was read, stating that he would prepare and submit to the board immediately an account of his method of gun-construction. (Filed. Indorsed No. 35.)

A letter from Lieutenant O. E. Michaelis was read, offering for consideration the French and Swedish method of constructing guns, and data respecting those guns. (Filed. Indorsed No. 37.)

The documents transmitted by the Chief of Ordnance, relating to W. E. Woodbridge's gun, were read. (Filed. Indorsed No. 38.)

W. E. Woodbridge being present, gave information respecting his plan.

The report of the trial of the Lyman multicharge gun, forwarded by the Chief of Ordnance, was read and filed. (Indorsed No. 39.)

It was decided to request the Chief of Ordnance to forward report of the trial of Dr. Woodbridge's gun at Springfield Armory, in the year 1866. (Letter-book No. 25.)

The board then adjourned till 10.30 a. m. of the 19th instant.

NEW YORK, *July 19, 1872.*

The board met, pursuant to adjournment, at 10.30 a. m., all the members being present.

A letter to the Secretary of War from E. R. McCabe, of Leighton, Mahaska County, Iowa, was read, asking for information as to the proper course to be pursued in order to bring his invention before the board. (Filed. Indorsed No. 40.)

The recorder was directed to write to E. R. McCabe, informing him of the answer of the board. (Letter-book, No. 28.)

A letter of James H. Tolman, of Saint Louis, Missouri, in behalf of Horace E. Dimick, to the Adjutant-General, was read, transmitting a printed expression of the views of Mr. Dimick on the subject of projectiles. (Filed. Indorsed No. 41.)

It was decided by the board to inform Mr. Dimick that the powers of the board, convened under General Orders No. 57, are confined to action in the selection of models for heavy cannon, and if he has any plans and specifications to submit of gun-construction, involving any special principles he wishes to advocate, if he will forward them, that they will receive consideration at the hands of the board. (Letter-book No. 29.)

Alban C. Stimers was present before the board, and submitted a communication and drawing explanatory of the Lyman multicharge gun. (Filed. Indorsed No. 42.)

The documents referred to by the letter of the Chief of Ordnance (No. 36) having arrived, were laid before the board and filed.

A letter from W. E. Woodbridge, further explaining his plan, was read and filed. (Indorsed No. 43.)

The letter of John A. Terrell, explaining his views at great length on the causes of failure in guns, and defending the plan upon which he proposes to build guns, was taken up and read. (No. 3 i, j, and n, and No. 21.)

The board then adjourned till 12 m. of the 22d instant.

NEW YORK, July 22, 1872.

The board met, pursuant to adjournment, at 12 m., all the members being present.

Two letters were read from Messrs. Cooper, Hewitt & Co., in reply to letter No. 18 from the board. (Filed. Indorsed Nos. 45 and 46.)

A letter was read from L. S. Parker, of Lockport, Illinois, to the Adjutant-General, asking information as to the course to be pursued in order to bring his patent before the board. Referred by the Adjutant-General to the Chief of Ordnance, and by the latter to the board, with the statement that the writer had been requested to send his papers to the board. (Filed. Indorsed No. 47.)

A letter was read from the Chief of Ordnance, transmitting the report of Lieutenant Colonel Laidley, of experiments upon a small Woodbridge gun. (Filed. Indorsed No. 44.)

Two letters from T. W. Clark, of Wausau, Wisconsin, were read, one addressed to the president of the board, the other to the recorder, and both having the same purport. They contained a description of a breech-loading cannon invented by him, but were unaccompanied either by a model or drawing.

The recorder was directed to acknowledge the receipt of these letters, which were filed. (Indorsed No. 48. Letter-book No. 30.)

Mr. Nathan Thompson being present, submitted to the board five models of breech-loading cannon and drawings of the same. (Filed. Indorsed No. 49. Models marked Nos. 1, 2, 3, 4, and 5.) Mr. Thompson further explained the history and details of his inventions.

The board then adjourned to 10.30 a. m. of the 23d instant.

NEW YORK, July 23, 1872.

The board met, pursuant to adjournment, at 10.30 a. m., all the members being present.

A letter from Jacob Reese, of Pittsburgh, Pennsylvania, was read, in reply to letter No. 22, stating his inability to construct a 12-inch gun with a body of Bessemer steel, there being no plant in the country adequate to the casting, and suggesting the construction of a 3-inch or 4½-inch gun; also offering to submit plans for a suitable plant for large guns. (Filed. Indorsed No. 51.)

The recorder was directed to inform Mr. Reese that the trial of a 3-inch or 4½-inch gun would not be satisfactory, as it would not be decisive of the success of such heavy rifles (10-inch or 12-inch) as come within the action of the board; but the board would be pleased to receive specifications for a 9-inch rifle, preparatory to the construction of a 10-inch and 12-inch rifle, and that for both of these (10-inch and 12-inch guns) specifications are invited, with estimates, in each case, of cost, &c., of the first gun, and subsequently for guns for service. (Letter filed. Indorsed No. 51.)

A letter from H. F. Mann, of Pittsburgh, Pennsylvania, was read, asking the board to name a day when he could be heard.

The recorder was directed to reply that his appearance is optional with himself, but that, if he chooses, the board will be pleased to hear him as soon as practicable. (Letter filed. Indorsed No. 50. Letter-book No. 32.)

Edwin Gomez being present, submitted to the board a sample of a new gunpowder and also his patent, No. 99,079, January 25, 1870, for a new cartridge, and explained its manufacture and operation.

A letter from W. E. Woodbridge was read, explaining the reason for delay in transmitting estimates of cost of building his gun. (Filed. Indorsed No. 54.)

A letter from Hermann Boker & Co. to Major Crispin, was read, transmitting a letter from the Bochum Company, and stating their ability to construct a 12-inch muzzle-loading gun, and their inability to construct a 12-inch breech-loading gun. A drawing of a 12-inch muzzle-loading gun was inclosed. (Filed. Indorsed No. 53.)

A letter from Hermann Boker & Co. to Major Crispin, transmitting drawings and various information respecting the guns constructed by J. Vavasseur, of London, England, was read, and the documents placed on file. (Indorsed No. 52.)

A copy of the work of Captain F. S. Stoney, R. A., on the construction and manufacture of rifled ordnance in the British service, was submitted by Major Crispin, and placed on file. (No. 55½.) Also a copy of the report (English) of the ordnance select committee on coiled wrought-iron inner tubes for ordnance. (Filed. Indorsed No. 55.)

The board then proceeded to consider the plan of John B. Moody, (No. 16,) of Cincinnati, Ohio, and to take final action thereon.

After a review of this plan and the documents relating to it, the following resolution was unanimously adopted:

Resolved, That the breech-closing arrangement presented by John B. Moody, of Cincinnati, Ohio, does not possess sufficient merit to warrant the board in recommending it for trial, with a view to its application to heavy ordnance.

The board then proceeded to final consideration and action upon the plans of William Wheeler Hubbell, of Philadelphia, Pennsylvania. (Nos. 3, 4, 5, and 27.)

The following resolution was passed unanimously:

Resolved, That the board does not recommend for experiments and tests, with a view to adoption for heavy ordnance, the mode of construction for a 12-inch rifle presented by William Hubbell, of Philadelphia, Pennsylvania, and marked A in his written description.

Action upon Mr. Hubbell's plan marked B was postponed for further consideration, and the board proceeded to consider his plan C.

The following resolution was passed unanimously:

Resolved, That the breech-closing arrangement presented by William Wheeler Hubbell, called plan C in his written description, does not possess sufficient merit to warrant the board in recommending it for trial, with a view to its application to heavy ordnance.

A communication was read from Edward L. Brown, of New York City, calling attention to his patent for casting iron upon wrought-iron. (Filed. Indorsed No. 57.)

The board then adjourned to 10.30 a. m. of the 24th instant.

NEW YORK, July 24, 1872.

The board met, pursuant to adjournment, at 10.30 a. m., all the members being present.

Three letters from C. Gagstatter, of Saint Louis, Missouri, transmitted by the Chief of Ordnance, giving views upon gunpowder and projectiles, and mentioning an invention of a cannon, were read.

The recorder was directed to acknowledge the receipt of these letters, and to invite him to submit his plans. (Letters filed. Indorsed No. 56. Letter-book No. 45.)

The board then proceeded to a consideration and final action upon the plan (file No. 21) proposed by John A. Terrell, of Bloomfield, Kentucky.

The following resolution was offered by Lieutenant-Colonel Laidley:

Resolved, That the board cannot assent to the arguments on which Mr. John A. Terrell, of Bloomfield, Kentucky, bases his theory of making guns, and does not recommend his plan for experiments and tests for heavy ordnance.

Lieutenant-Colonel Wright moved the following amendment, viz, to strike out all after the word "resolved," and to substitute the following: "That the board does not recommend for experiments and tests, with a view to adoption for heavy ordnance, the mode of construction for guns of large caliber presented by Mr. John A. Terrell, of Bloomfield, Kentucky."

The amendment of Lieutenant-Colonel Wright was passed.

AYES—Colonel Whiteley, Colonel Getty, Lieutenant-Colonel Wright, Major Seymour, and Major Crispin—5.

NOES—Lieutenant-Colonel Laidley and Lieutenant Dutton—2.

The resolution as amended was then passed unanimously.

The following resolution was also passed unanimously:

Resolved, That the board does not recommend for experiments and tests the breech-loading arrangement presented by Mr. John A. Terrell, of Bloomfield, Kentucky, for heavy ordnance.

The plan (No. 3 l and No. 11) of L. W. Wright, of Brooklyn, New York, was taken up for consideration, but final action was postponed.

A letter from H. J. Allen, of Arkadelphia, Arkansas, was read, transmitting a drawing of his gun. (Filed. Indorsed No. 58.)

The board then proceeded to consider and take final action upon the plans (file No. 9) of William Fields, of Wilmington, Delaware.

The following resolutions were passed unanimously:

Resolved, That the "improvement in battery-guns" invented by Dr. William Fields, of Wilmington, Delaware, being inapplicable to guns of heavy caliber, does not properly come within the action of this board.

Resolved, That the projectiles and mode of making powder submitted by Dr. William Fields, of Wilmington, Delaware, are not properly subjects of consideration by this board.

The plan (file No. 3 m and No. 58) of H. J. Allen, of Arkadelphia, Arkansas, was then taken up for consideration and final action.

The following resolution was passed unanimously:

Resolved, That the breech-closing arrangement and mode of gun-construction presented by H. J. Allen, of Arkadelphia, Arkansas, do not possess sufficient merit to warrant the board in recommending them for trial with a view to their application to heavy ordnance.

The plans (file No. 26) of Alexander T. Loyd, of Chicago, Illinois, were then taken up for final consideration and action.

The following resolution was passed unanimously:

Resolved, That the board does not recommend for experiments and tests the plans submitted by Mr. Alexander T. Loyd, of Chicago, Illinois, for constructing heavy ordnance and projectiles.

The board then adjourned to 10.30 a. m. of the 25th instant.

NEW YORK, July 25, 1872.

The board assembled, pursuant to adjournment, at 10.30 a. m., all the members being present.

A telegram was read from H. J. Allen, of Arkadelphia, Arkansas, inquiring if his presence is necessary. (Filed. Indorsed No. 59.)

The recorder was instructed to reply by telegram in the negative. (Letter-book, No. 33.)

A letter from James F. Hall, attorney for James A. Ball, was read, with a description, accompanied by a drawing, explaining the projectile and breech-loading cannon already submitted by him. (Filed. Indorsed No. 61.)

A letter from Thomas Prosser & Son, of New York City, to Major Crispin, and submitted by Major Crispin, was read, conveying the offer of Frederick Krupp, of Essen, Prussia, to supply a 9-inch or 11-inch breech-loading rifle and projectiles, without expense to the Government, subject to certain conditions; also, a price-list of the Krupp guns. (Filed. Indorsed No. 60.)

The board then proceeded to a discussion of the Lyman multicharge gun, which was postponed in order to enable Edward L. Brown to explain to the board his invention for casting cast-iron upon wrought-iron.

W. E. Woodbridge, being present, submitted estimates of the cost of making 8-inch and 12-inch rifles, which were filed, (indorsed No. 62.) He also explained further several points connected with his plan for constructing cannon.

Alban C. Stimers, being present in behalf of the Lyman multicharge gun, gave the board further information respecting that cannon.

The further consideration of the Lyman multicharge gun was postponed.

The following resolution was passed unanimously:

Resolved, That the board does not recommend for experiments and tests the plan (file No. 19) proposed by Daniel Fitzgerald, of New York City, for constructing heavy ordnance.

The proposition (file No. 25) of D. K. Swisher, of Union City, Indiana, was then taken up.

The following resolution was passed unanimously:

Resolved, That the proposition of D. K. Swisher, of Union City, Indiana, does not come within the purview of the board, not being applicable to heavy ordnance.

Charles Alger, of Frostburgh, Maryland, being present, gave the board further information respecting his plan, and submitted a model of his breech-loading cannon. (Filed. No. 63.)

The board then adjourned to 10.30 a. m. of the 26th instant.

NEW YORK, July 26, 1872.

The board met, pursuant to adjournment, at 10.30 a. m., all the members being present.

The plans (No. 29) of Henry Durell, of Morrisania, New York, were taken up and the following resolution was passed unanimously:

Resolved, That the board does not recommend for experiments and tests the plans proposed by Henry Durell, of Morrisania, New York, for heavy ordnance.

The plan (No. 3 g and h and No. 33) of A. W. Kercheval, of Romney, West Virginia, was then taken up, and the following resolution was passed unanimously:

Resolved, That the board does not recommend for experiments and tests the plan of a section battery proposed by A. W. Kercheval, of Romney, West Virginia, it not being applicable to heavy ordnance.

The plan (No. 48) of T. W. Clark, of Wausau, Wisconsin, was then taken up, and the following resolution was passed unanimously:

Resolved, That the board does not recommend for experiments and tests the plan proposed by T. W. Clark, of Wausau, Wisconsin, for breech-loading cannon.

The communication of Edwin Gomez was then taken up, and the following resolution was passed unanimously:

Resolved, That the communication of Edwin Gomez, having reference to powder and projectiles, does not come within the action of the board.

Alban C. Stimers, being present, gave further explanations of the Lyman multicharge gun, and submitted a communication respecting the dimensions and cost of the gun. (Filed. Indorsed No. 64.)

Printed documents were submitted by Daniel Fitzgerald and Alonzo Hitchcock, which were filed, (indorsed Nos. 65 and 65½.)

H. F. Mann, being present, explained his method of constructing guns, and promised to submit a written description and a model on the 30th instant.

Daniel Fitzgerald, being present, explained to the board his plan for a submerged cannon, exhibiting a model.

The following resolution was passed unanimously:

Resolved, That the board adjourn until August 7, 12 m., in order to give time to such

persons as have signified their intentions to submit further matter to complete the same, and that they be informed that they are expected to lay before the board such additional information on or before that date.

NEW YORK, August 7, 1872.

The board met, pursuant to adjournment, at 12 m., all the members being present.

Two letters from Lieutenant J. G. Butler, of Ordnance, were read, transmitting a document explaining his views on rifling and projectiles, with drawings. (Filed. Indorsed Nos. 67 and 68.)

A letter from H. F. Mann was read, containing a proposition to construct a 12-inch breech-loading rifle. (Filed. Indorsed No. 66.) A model of his gun was also received, (No. 66.)

A letter from Thomas Prosser & Son, in behalf of Fried. Krupp, was submitted, containing a statement of the views and wishes of Mr. Krupp in furnishing a trial gun. (Filed. Indorsed No. 69.)

J. H. Cogill, being present in behalf of E. W. Dunlop, submitted a paper explaining the plan of the latter for constructing a breech-loading cannon and projectiles. (Filed. Indorsed No. 70.)

A letter of E. R. McCabe, of Leighton, Iowa, to the Secretary of War, and transmitted to the board by the Chief of Ordnance, was read, urging the consideration of his proposition to use gun-cotton. (Filed. Indorsed No. 73.)

A letter of E. R. McCabe to the board, explaining his plan for the construction of a breech-loading gun, using gun-cotton, was read. (Filed. Indorsed No. 72.) Also, another letter transmitting his letters-patent of a breech-loading gun. (Filed. Indorsed No. 71.) A model in wood was also received and placed on file; (No. 72.)

The following resolution was adopted unanimously:

Resolved, That the board does not recommend for experiments and tests the plan presented by E. R. McCabe, of Leighton, Iowa, for a breech-loading cannon.

Nathan Thompson, being present, gave further argument in favor of his system of breech-loading guns. A printed circular, presented by Mr. Thompson, setting forth the advantages of his system, was also received. (Filed. Indorsed No. 78.)

Daniel Fitzgerald, being present, discussed further his proposed method of utilizing water in restraining the force of powder in cannon.

A letter of C. W. Stafford, of New York, was read, asking if his plans would be considered by the board. (Filed. Indorsed No. 74.)

The recorder was instructed to inform Mr. Stafford that his propositions would be considered, if forwarded immediately. (Letter-book No. 44.)

A letter from L. S. Parker, of Lockport, Illinois, was read, transmitting letters-patent of a breech-loading gun, which he desired to lay before the board. (Filed. Indorsed No. 75.)

The following resolution was passed unanimously:

Resolved, That the board does not recommend for experiments and tests the plan of a breech-loading gun submitted by L. S. Parker, of Lockport, Illinois, as described in letters-patent No. 74,557, granted to Lucius M. Lull and James T. Starr.

A letter from E. Wiler Dunlop was read, stating that he had been unable to prepare and arrange his drawings, &c., of a projectile for the action of the board. (Filed. Indorsed No. 70.)

A letter was read from C. Gagstatter, of Saint Louis, Missouri, referring to a breech-loading cannon invented by him. (Filed. Indorsed No. 77.)

The recorder was instructed to write to Mr. Gagstatter, inviting him to lay his drawings and descriptions before the board. (Letter-book No. 45.)

A letter from Clifford Arrick was read, having reference to his projectiles and their effects upon rifled cannon. (Filed. Indorsed No. 76.)

The board then adjourned to 10.30 a. m. of the 8th instant.

NEW YORK, August 8, 1872.

The board met, pursuant to adjournment, at 10.30 a. m., all the members being present.

A letter from S. L. Cutler, of San Francisco, California, to the Secretary of War, was read, transmitting a copy of the San Francisco Scientific Press, containing an account of the breech-loading cannon invented by A. F. Potter, of Oakland, California. The letter asked for a consideration by the board of this gun. (Filed. Indorsed No. 80.)

The following resolution was adopted unanimously:

Resolved, That the board does not recommend for experiments and tests the breech-loading gun submitted by Samuel L. Cutler in behalf of A. F. Potter, of Oakland, California.

A letter from Jacob Reese, of Pittsburgh, Pennsylvania, was read, stating his readiness to contract for a 12-inch rifle of Bessemer steel, with a tube of crucible steel, and his intention to send specimens of metal and a partial estimate of the cost of making the proposed gun. (Filed, indorsed No. 79.)

The paper of Lieutenant J. G. Butler, United States Ordnance Corps, (No. 68,) was then taken up and read.

The Lyman multicharge gun was then discussed, and the following resolution was passed unanimously:

Resolved, That inasmuch as a 6-inch Lyman multicharge gun is now constructed and ready for experimental firing at Reading, Pennsylvania, and the improvement claimed is for the purpose of giving greatly increased initial velocities, without corresponding increase of pressures, the board recommends, if the proprietor consents, that said gun be subjected to such trial as may be necessary, to test the principles of its construction, and that the cost of the powder and projectiles used in such experiments, with all the expenses attending the test, but not the cost of the gun, be borne by the United States.

The board then proceeded to a discussion of the plan of Norman Wiard, and the following resolution was unanimously adopted:

Resolved, In consideration of the fact that the system proposed by Norman Wiard, of cast-iron guns of heavy caliber, in which a special system of projectiles and rifling is designed, with a view to obtaining a combination gun possessing the qualities of both a smooth-bore and rifle, is to be tested under the direction of the Secretary of the Navy, under the act of May 28, 1872, the board does not recommend his proposed 12-inch rifled gun, involving the same principles as the gun referred to above, for experiments and tests under the provisions of the act of Congress approved June 6, 1872.

The plan of Dr. W. E. Woodbridge was then taken up and discussed, and the following resolution was passed unanimously:

Resolved, That the board recommends the plan of constructing heavy ordnance proposed by Dr. W. E. Woodbridge, of Little Falls, New York, as one of the systems for experiments and tests under the provisions of the act of June 6, 1872, and that the gun be fabricated according to designs and specifications approved by the War Department.

The system of Frederick Krupp was then taken up, and the following resolution was passed unanimously:

Resolved, That the board recommends that a Krupp 12-inch breech-loading steel rifled gun be procured for experiments and tests under the provisions of the act of June 6, 1872, both as a representative of a breech-loading system and one of gun-construction.

The board then adjourned to 10.30 a. m. of the 9th instant.

NEW YORK, August 9, 1872.

The board met, pursuant to adjournment, at 10.30 a. m., all the members being present.

A letter from the Adjutant-General, in reply to letter from the board (No. 13) of July 13, was read, giving the desired information respecting the number of sea-coast guns required and notifying the board of the forwarding of vols. v, vi, and vii of Proceedings of the Royal United Service Institution. (Filed. Indorsed No. 81.)

A letter from the Chief of Ordnance was read, transmitting extracts copied from the reports of Captains Simpson and Marvin, of the Navy, upon European ordnance. The extracts were read in part. (Documents filed. Indorsed No. 82.)

A letter from Charles Alger, of Frostburgh, Maryland, was read, stating his desire to construct a 12-inch rifle on his plan. (Filed. Indorsed No. 83.)

The following resolution was offered by Lieutenant-Colonel Laidley, but was laid upon the table for the present:

Resolved, That the board recommends the plan of constructing heavy cannon patented by Mr. Alonzo Hitchcock, of New York City, as one of the systems selected for experiments and tests under the act of June 6, 1872, the gun to be fabricated according to drawings and specifications approved by the War Department.

The board then adjourned to 12 m. of the 12th instant.

NEW YORK, August 12, 1872.

The board met, pursuant to adjournment, at 12 m., all the members being present.

A letter from E. R. McCabe, of Leighton, Iowa, was read, conveying further information respecting his breech-loading canon. (Filed. Indorsed No. 85.)

A letter of Jacob Reese, of Pittsburgh, Pennsylvania, was read, stating the terms upon which he would be willing to make a gun according to his plan. (Filed. Indorsed No. 84.)

A letter from C. W. Stafford, of New York City, respecting the use of a process for strengthening cast iron, was read. (Filed. Indorsed No. 86.)

The reading of the extracts from the dispatches of Captains Simpson and Marvin was continued.

Two letters from Alex. T. Loyd, of Chicago, Illinois, proposing modifications in the cartridges for cannon, were read. (Filed. Indorsed No. 87.)

The plan of Alonzo Hitchcock (No. 30) was then taken up and discussed, and it was decided to ask Mr. Hitchcock to furnish the board, as soon as possible, with estimates of the probable cost of the plant for his special method of gun-construction; also, as to the cost of a 12-inch rifle, constructed on his plan, and accompanied by such further information regarding the details of his method as he may be able to furnish.

The proposition of C. W. Stafford, (No. 86,) of New York City, was taken up, and the following resolution was adopted unanimously:

Resolved, That the board does not recommend for experiments and tests the gun proposed by C. W. Stafford, of New York City.

The board then proceeded to consider the plan proposed by William Wheeler Hubbell, (No. 27,) of Philadelphia, Pennsylvania, and designated by him plan B.

The following resolution was adopted unanimously:

Resolved, That the board does not recommend for experiments and tests, with a view to adoption for heavy ordnance, the mode of construction for a 12-inch rifle presented by William Wheeler Hubbell, of Philadelphia, Pennsylvania, and marked B in his written description.

The board then adjourned to 10.30 a. m. of the 13th instant.

NEW YORK, August 13, 1872.

The board met, pursuant to adjournment, at 10.30 a. m., all the members being present.

The board proceeded to final action upon the plan proposed by E. Wiler Dunlop, (No. 70.)

The following resolution was adopted unanimously:

Resolved, That the board does not recommend for experiments and tests the gun and projectile proposed by E. Wiler Dunlop, of Trenton, New Jersey.

A letter from Rear-Admiral A. Ludlow Case, chief of naval Bureau of Ordnance, and transmitted by the Chief of Ordnance, was read. The letter was accompanied by a report of Captain W. N. Jeffers of a trial of J. B. Moody's breech-loading gun. (Filed. Indorsed No. 88.)

The board then proceeded to final action on the plans presented by James A. Ball, (Nos. 23 and 61.)

The following resolution was adopted unanimously:

Resolved, That the board does not recommend for experiments and tests the breech-loading gun proposed by James A. Ball, of Cold Spring, New York, nor his system of projectiles.

The board then proceeded to discuss the proposition of H. F. Mann, (Nos. 1 and 66,) of Pittsburgh, Pennsylvania. It was decided to request the Chief of Ordnance to forward the reports of the trial of Mann's 8-inch breech-loading gun, and further discussion was postponed.

The plan of Edward L. Brown, (Nos. 3 f, 6, and 57,) presented by his attorney, Treadwell Cleveland, was then taken up, and the following resolution was passed unanimously:

Resolved, That the board does not recommend for experiments and tests the method of gun-construction presented by Treadwell Cleveland, in behalf of Edward L. Brown, of Philadelphia, Pennsylvania.

The plan of Lemuel W. Wright, (No. 3 l and No. 11,) of Brooklyn, New York, was then taken up and discussed. It was decided to inquire of Mr. Wright concerning the cost of constructing his proposed gun.

The proposition of the Bochum Mining and Manufacturing Company, (Nos. 8 and 53,) submitted through Hermann Boker & Co., of New York, was taken up, and the following resolution was passed unanimously:

Resolved, In view of the fact that a Krupp breech-loader has been selected as one of the models for experiments and tests under the provisions of the act of Congress approved June 6, 1872, the board does not recommend for trial the cast-steel muzzle-loader of similar construction manufactured by the Bochum Manufacturing Company of Prussia.

A telegram was received from H. F. Mann, of Pittsburgh, Pennsylvania, asking permission to appear personally before the board.

The recorder was instructed to reply. (Filed. Indorsed No. 89; letter-book No. 51.)

The board then proceeded to consider the plan of Jacob Reese, of Pittsburgh, Pennsylvania, (Nos. 28, 79, and 84.)

The following resolution was passed unanimously:

Resolved, In view of the excessive price asked by Jacob Reese, of Pittsburgh, Pennsylvania, as presented in his offer of the 10th instant, (No. 84,) for a 10-inch rifle constructed on his plan, the board does not recommend this gun for experiments and tests under the provisions of the act of Congress approved June 6, 1872.

The communications of Clifford Arrick (Nos. 31 and 76) were taken up, and the following resolution was passed unanimously:

Resolved, That, as the papers submitted by Mr. Arrick present no features coming within the purview of the board, no further action is necessary.

The board then adjourned to 10.30 a. m. of the 14th instant.

NEW YORK, August 14, 1872.

The board met, pursuant to adjournment, at 10.30 a. m., all the members being present.

A letter from the Chief of Ordnance was read, transmitting the report on an 8-inch gun of Mauu's pattern. (Filed. Indorsed No. 90.)

The board then proceeded to a consideration of the propositions of Nathan Thompson, (Nos. 20 and 49,) of Brooklyn, New York, and, after discussion, they were laid over for the present.

A letter was received from Merritt W. Griswold, of New York, calling attention to the breech-loading and breech-recoiling gun invented by Mr. Henson. The letter was accompanied by a drawing. Mr. Griswold, who was present, was invited to meet the board on Monday next. (Letter filed. Indorsed No. 91.)

The board then discussed the feasibility of a plan of converting cast-iron smooth-bores into rifles. No conclusion being reached, the board adjourned to 11 a. m. of the 15th instant.

NEW YORK, August 15, 1872.

The board met, pursuant to adjournment, at 11 a. m., all the members being present. A letter was read from George A. Thurston, of Cumberland, Maryland, in behalf of Mr. Charles Alger's plan for a breech-loading cannon. (Filed. Indorsed No. 92.)

Alonzo Hitchcock, being present, gave the board information respecting his plan for constructing a 12-inch rifle, and was again requested to furnish an estimate of the cost of the required plant, and of subsequent guns.

Lenuel W. Wright, being present, was again invited to furnish the board with an estimate of the cost of constructing a 12-inch rifle according to his plan.

The board then proceeded to a consideration of a plan for converting cast-iron smooth-bore guns into rifles. The following resolution was adopted:

Resolved, That the board recommends, in order to test the system of gun-conversion by lining with wrought-iron or steel tubes, (as brought to the notice of the board in a communication addressed to the Chief of Ordnance by Major S. Crispin, and referred to the board by the Ordnance Bureau,) that four 10-inch smooth-bore Rodman guns be converted to muzzle-loading rifles, using two calibers, two of the guns to have a caliber of not less than 8 inches, and two to have a caliber of not more than 9 inches; and, further, that two of the guns be converted by tubing from the rear end and two by tubing from the front; the character of the metal lining, whether of steel or wrought iron, and other details of conversion, to be determined by the War Department.

Lieutenant-Colonel Laidley voted negatively and the rest of the board affirmatively.

The following resolution was also passed:

Resolved, That the board recommends, in order to test the efficiency of the French and Swedish breech-closing arrangement, that a 10-inch Rodman smooth-bore gun, converted to a rifle in such manner and of such caliber, not less than 8 or more than 9 inches, as may be determined by the War Department, and conditional upon the success of tests, with the four 10-inch guns converted under the previous resolution, be provided with that *fermeture* and the gun be submitted to test and experiment under the act of June 6, 1872.

Lieutenant-Colonel Laidley voted negatively and the rest of the board affirmatively.

The board then adjourned to 10.30 a. m. of the 16th instant.

NEW YORK, August 16, 1872.

The board met, pursuant to adjournment, at 10.30 a. m., all the members being present.

The board then proceeded to discuss the plan of J. Vavasseur, of London, England, (No. 52.) No conclusion being reached, the subject was laid over for the present.

The papers of Nathan Thompson were then taken up and discussed, and it was decided to write to Mr. Thompson requesting him to appear before the board some day next week for consultation. (Letter-book, No. 53.)

The board then proceeded to a consideration of the recommendations of Lieutenant J. G. Butler, Ordnance Corps. No conclusion being reached, the board adjourned to 12 m. of the 19th instant.

NEW YORK, August 19, 1872.

The board met, pursuant to adjournment, at 12 m., all the members being present. H. F. Mann, of Pittsburgh, Pennsylvania, being present by appointment, gave the

board information respecting his plan for a breech-loader and submitted a drawing for a proposed 12-inch rifle. (Filed. Indorsed No. 95.)

A letter was read from Charles Alger, of Frostburgh, Maryland, indicating some of the details he would propose to adopt in the construction of a 10-inch breech-loading rifle according to his plan. (Filed. Indorsed No. 93.)

A letter was read from Samuel L. Cutler, of San Francisco, California, asking the attention of the board to Potter's breech-loading needle cannon. (Filed. Indorsed No. 94.)

Messrs. Merritt Griswold and Henson, being present, exhibited a model of the Henson gun, and described its mode of performance and its construction. After the withdrawal of these gentlemen, the gun was discussed and the following resolution was passed unanimously:

Resolved, That the board does not recommend for experiments and tests, under the provisions of the act of June 6, 1872, Henson's breech-loading and breech-recoiling gun, presented by Merritt W. Griswold.

The board then proceeded to a final consideration of the plan of Charles Alger, and the following resolution was passed unanimously:

Resolved, That the board does not recommend for experiments and tests, under the provisions of the act of June 6, 1872, the plan of a breech-loading gun presented by Charles Alger, of Frostburgh, Maryland.

The board then proceeded to a final consideration of the gun proposed by H. F. Mann, of Pittsburgh, Pennsylvania, and the following resolution was passed unanimously:

Resolved, That inasmuch as the Ordnance Department is now in possession of an 8-inch breech-loading rifle constructed according to the plan of H. F. Mann, of Pittsburgh, Pennsylvania, which has not, in the opinion of the board, been yet fired a sufficient number of times to fully test the value of the invention, even when applied to that caliber, the board does not now recommend the construction of a 12-inch rifle according to his proposition for experiments and tests, under the act of June 6, 1872, but that such further trials as may be deemed necessary be made with the 8-inch gun referred to.

The board then adjourned to 10.30 a. m. of the 20th instant.

NEW YORK, *August 20, 1872.*

The board met, pursuant to adjournment, at 10.30 a. m., all the members being present.

A letter was read from Nathan Thompson, in reply to letter No. 53, stating that he would appear before the board on the 22d instant. (Filed. Indorsed No. 96.)

A copy of the report of the board on wrought-iron guns manufactured by Horatio Ames was submitted by Major Crispin and read. (Filed. Indorsed No. 93.)

Alonzo Hitchcock, being present, submitted a partial estimate of the cost of constructing a 12-inch rifled gun on his plan. (Filed. Indorsed No. 97.) After his departure the board proceeded to a discussion of his plan, but, no conclusion was reached.

Daniel Fitzgerald, being present, submitted another model of a gun, which was filed, (indorsed No. 99.)

The board then adjourned to 10.30 a. m. of the 21st instant.

NEW YORK, *August 21, 1872.*

The board met, pursuant to adjournment, at 10.30 a. m., all the members being present.

The proposition of Lieutenant J. G. Butler was taken up, and the following resolution was passed unanimously:

Resolved, That this board has read and considered with much interest the paper submitted by Lieutenant J. G. Butler, of the Ordnance Corps, upon the subject of rifling and projectiles for heavy ordnance, and while it does not recommend the cast-iron muzzle-loading 12-inch rifle proposed by him for experiments and tests under the act of Congress of June 6, 1872, it desires to express the opinion that the hope of employing cast-iron as a material for the construction of heavy guns should not be abandoned, but that the experiments by the Ordnance Department with expanding projectiles and various modes of rifling and kinds of powder be continued with a view to obtaining such accuracy of movement of projectiles and uniformity of pressures as shall render admissible the use of cast-iron in heavy-ordnance construction.

The board then proceeded to a consideration of the plan of Alonzo Hitchcock, and the following resolutions were adopted:

Resolved, That the board recommends for experiments and tests, under the act of June 6, 1872, a 12-inch muzzle-loading rifle, to be constructed after the manner proposed by Mr. Alonzo Hitchcock, of New York City, the blocks or disk of which the gun is composed to be of an interior ring of low or welding steel, provided a steel of suitable

welding qualities can be obtained, and, if not, then of wrought iron, and of an outer ring of similar steel, or of wrought iron, as may be determined by the War Department.

Resolved, also, That if, in the opinion of the War Department, the construction of a preliminary gun of smaller caliber, not less than 9 inches, be necessary in order to facilitate the fabrication of the 12-inch rifle, such preliminary gun is recommended to be made under the provisions of the act of June 6, 1872.

Lieutenant Dutton voted negatively and the remainder of the board affirmatively.

The board then proceeded to a consideration of the plan of J. Vavasseur, of London, England, and the following resolution was adopted unanimously:

Resolved, In consideration of the fact that a well-established representative system of cast-steel built-up gun-construction has already been recommended for experiments and tests, the importance at present of trying another built-up steel gun-construction is not apparent to the board, and hence, while recognizing the merits of Mr. Vavasseur's system, it does not recommend the procurement of a gun on his plan for experiments and tests under the act of June 6, 1872.

The board then adjourned to 10.30 a. m. of the 22d instant.

NEW YORK, August 22, 1872.

The board met, pursuant to adjournment, at 10.30 a. m., all the members being present.

A communication from C. Gagstatter, of Saint Louis, Missouri, accompanied by a drawing, was read, explaining the details of his plan for a breech-loading cannon. (Filed. Indorsed No. 100.)

E. A. Sutcliffe, of New York City, being present, submitted a model of a breech-loading mechanism, and his letters-patent No. 39,596 referring to this invention. (Filed. Indorsed No. 101.)

The plan of C. Gagstatter was then taken up, and the following resolution was passed unanimously.

Resolved, That the board does not recommend for experiments and tests, under the act of June 6, 1872, the breech-loading arrangement for heavy guns proposed by Mr. Gagstatter, of Saint Louis, Missouri.

Nathan Thompson, being present, was consulted by the board respecting the cost of subsequent guns upon his plan and upon the general features of his proposition.

A letter from Merritt Griswold was read, having reference to Henson's breech-loading and breech-recoiling gun. (Filed. Indorsed No. 102.)

The board then proceeded to consider the plan of E. A. Sutcliffe, and the following resolution was passed unanimously:

Resolved, That the board recommends, under the act of June 6, 1872, for tests and experiments, the breech-loading system invented by E. A. Sutcliffe, of New York City, and that it be applied to a cast-iron 8-inch rifle, lined with a steel tube, the details of the construction to be determined by the War Department.

The board then adjourned to 10.30 a. m. of the 23d instant.

NEW YORK, August 23, 1872.

The board met, pursuant to adjournment, at 10.30 a. m., all the members being present.

Nathan Thompson, being present, submitted to the board an estimate of the cost of constructing subsequent guns on his plan. (Filed. Indorsed No. 104.)

The board then proceeded to final action upon the propositions of Nathan Thompson, and the following resolution was passed:

Resolved, That the board does not recommend the acceptance of either of the proposals of Mr. Nathan Thompson, of Brooklyn, New York, but recommends the fabrication by the United States of a cast-iron 8-inch rifle, lined with a steel tube, for experiments and tests under the act of June 6, 1872, on his plan for breech-loading heavy ordnance, Mr. Thompson consenting thereto, the details of construction to be submitted by him to, and to be approved by, the War Department.

Lieutenant-Colonel Laidley voted in the negative and the remainder of the board in the affirmative.

The board then proceeded to a consideration of the plan of Lemuel W. Wright, and the following resolution was adopted:

Resolved, That the board does not recommend for experiments and tests, under the act of Congress of June 6, 1872, the plan for constructing heavy guns proposed by Lemuel W. Wright, of Brooklyn, New York.

AYES—Colonel Whiteley, Lieutenant-Colonel Laidley, Major Seymour, Major Crispin, and Lieutenant Dutton—5.

NOES—Colonel Getty and Lieutenant-Colonel Wright—2.

There being no further plans or propositions before it requiring final action, the

board then proceeded to determine the order in which to arrange for recommendation the selected models, which was determined as follows:

Muzzle-loaders:

1. Dr. W. E. Woodbridge's.
2. Alonzo Hitchcock's.
3. Converted guns.

Breech-loaders:

1. Krupp's.
2. E. A. Sutcliffe's.
3. Nathan Thompson's.
4. French and Swedish.

Miscellaneous:

- H. F. Mann's.
Lyman's multicharge.

The board then proceeded to consider the report to be made of its action and decisions, and, after consultation, adjourned to 10 a. m. of the 24th instant.

NEW YORK, *August 24, 1872.*

The board met, pursuant to adjournment, at 10 a. m., all the members being present.

The entire proceedings of the board were then read and approved.

The consideration of the subject of the report was resumed and final action taken as follows:

RECOMMENDATIONS.

The board has discussed and considered with care and deliberation the various inventions and proposals indicated in the foregoing proceedings and recapitulated, as follows:

- | | |
|--------------------------------|-------------------------------------|
| 1. Allen, H. J. | 21. Hubbell, W. W. |
| 2. Alger, Charles. | 22. Kercheval, A. W. |
| 3. Arrick, Clifford. | 23. Krupp, F. |
| 4. Ball, James A. | 24. Loyd, A. T. |
| 5. Bochum Company. | 25. Lyman, A. S. |
| 6. Brown, E. B. | 26. Mann, H. F. |
| 7. Brown, Edward L. | 27. McCabe, E. R. |
| 8. Butler, Lieutenant J. G. | 28. Moody, J. B. |
| 9. Clark, T. W. | 29. Parker, L. S. |
| 10. Cutler, S. L. | 30. Parsons's system of conversion. |
| 11. Dimick, Horace E. | 31. Reese, Jacob. |
| 12. Dunlop, E. W. | 32. Stafford, C. W. |
| 13. Durell, Henry. | 33. Sutcliffe, E. A. |
| 14. Fields, Doctor William. | 34. Swisher, D. K. |
| 15. Fitzgerald, Daniel. | 35. Terrell, John A. |
| 16. French and Swedish system. | 36. Thompson, Nathan. |
| 17. Gagstatter, C. | 37. Vavasseur, J., & Co. |
| 18. Gomez, Edwin. | 38. Wiard, Norman. |
| 19. Griswold, M. W. | 39. Woodbridge, Doctor W. E. |
| 20. Hitchcock, Alonzo. | 40. Wright, L. W. |

The detailed description of these proposals will be found in the appendix to this report.

From the above the board has selected the following models, including breech and muzzle loading cannon, for tests and experiments under the act of June 6, 1872, and in accordance with the resolutions embodied in the proceedings:

Muzzle-loading guns:

1. Doctor W. E. Woodbridge's.
2. Alonzo Hitchcock's.
3. Cast-iron guns, lined with wrought-iron or steel tubes.

Breech-loading guns:

1. Friedrich Krupp's.
2. E. A. Sutcliffe's.
3. Nathan Thompson's.
4. French and Swedish system.

Miscellaneous:

- H. F. Mann's.
Lyman's multicharge.

It will be seen from resolutions passed by the board that further trials are recommended with Mann's 8-inch breech-loading rifle and Lyman's 6-inch multicharge gun. Should the appropriation under the act of June 6, 1872, not prove sufficient to include all the models selected by the board, it recommends that the appropriation be expended upon them in the order in which they are named.

The board, having no further business before it, then adjourned *sine die*.

R. H. K. WHITELEY,
Colonel of Ordnance, President.
GEO. W. GETTY,
Colonel Third Artillery, Brevet Major-General, U. S. A.
H. G. WRIGHT,
Lieutenant-Colonel of Engineers, Brevet Major-General.
T. T. S. LAIDLEY,
Lieutenant-Colonel of Ordnance.
T. SEYMOUR,
Major, Fifth Artillery.
S. CRISPIN,
Brevet Colonel, U. S. A., Major of Ordnance.
C. E. DUTTON,
First-Lieutenant of Ordnance.

[Indorsement.]

ORDNANCE-OFFICE, September 18, 1872.

Respectfully submitted to the Secretary of War, approved.

It is recommended that this Bureau be authorized to assemble a board of ordnance officers to fix the place, manner, and details of the construction of these guns.

A. B. DYER,
Chief of Ordnance United States Army.

Approved:

WM. W. BELKNAP,
Secretary of War.

DOCUMENTS PERTAINING TO THE REPORT OF PROCEEDINGS OF THE BOARD ON HEAVY ORDNANCE, INSTITUTED UNDER THE PROVISIONS OF THE ACT OF JUNE 6, 1872, AND CONVENED BY GENERAL ORDERS No. 57, ADJUTANT-GENERAL'S OFFICE, DATED JUNE 28, 1872.*

PAPERS SENT FROM THE OFFICE OF THE CHIEF OF ORDNANCE.

H. O. No. 3.]

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, D. C., July 8, 1872.

SIR: In compliance with the instructions contained in General Orders No. 57, Adjutant-General's Office, of 1872, I enclose herein, for the information of the board on heavy ordnance, the following papers † from the files of this office, being introductory and explanatory of various inventions and improvements in ordnance:

Office-register number.	Inventor.	Address.	Date of letter.
12, 1871.....	John Robbins.....	Saint Louis, Mo.....	
1238, 1871.....	A. J. Dull.....	Kittanning, Pa.....	Dec. 21, 1870
1305, 1871.....	John A. Terrell.....	Bloomfield, Ky.....	Mar. 11, 1871
1632, 1871.....	do.....	do.....	Dec. —, 1871
5420, 1871.....	do.....	do.....	
3083, 1872.....	do.....	do.....	May 16, 1872
2369, 1871.....	H. J. Allen.....	Arkadelphia, Ark.....	May 10, 1871
3895, 1871.....	L. W. Wright.....	Brooklyn, N. Y.....	Aug. 18, 1871
4155, 1871.....	W. W. Hubbell.....	Philadelphia, Pa.....	Sept. 11, 1871
594, 1872.....	A. W. Kercheval.....	Romney, W. Va.....	Feb. 2, 1872
842, 1872.....	do.....	do.....	Feb. 21, 1872
617, 1872.....	E. L. Brown.....	27 Wall street, N. Y., Treadwell Cleveland, att'y.....	Feb. 8, 1872
1295, 1872.....	H. Burin.....	New York City.....	Mar. 20, 1872
2157, 1872.....	E. R. McCabe, M. D.....	Leighton, Iowa.....	May 2, 1872
2172, 1872.....	A. T. Loyd.....	Chicago, Ill.....	May 6, 1872

* NOTE.—These documents do not comprise all that were submitted to the board. Such papers only as are deemed necessary to an understanding of the various methods of construction proposed are herewith published, accompanied, in some cases, by the correspondence of the board with the inventors. The drawings have been reduced from the originals laid before the board.

† Such of the communications inclosed in this letter as are deemed of sufficient importance are embraced in the documents printed herewith.

I inclose three copies each of ordnance memoranda Nos. 9 and 10, for the use of the board, and invite attention to the various recommendations of the boards of 1863 and 1870 upon the subject of ordnance.

I inclose also a communication of Major S. Crispin, of June 12, 1872, (2809, 1872) upon the subject of the introduction of rifled guns into our granite casemated sea-coast defenses, &c., for the consideration of the board.

I inclose also a list of persons who have been specially furnished, from this office, with a copy of General Orders No. 57, Adjutant-General's Office, of 1872.

The Bureau will supply the board with any further information that may be on its files upon an intimation from the board as to the nature of the information desired.

Respectfully, your obedient servant,

By order of the Chief of Ordnance :

S. V. BENÉT,
Major of Ordnance.

Colonel R. H. K. WITELEY,
*President of Board on Heavy Ordnance,
New York City, New York.*

[Inclosure.]

A copy of General Orders No. 57, Adjutant-General's Office, 1872, was sent to each of the following persons on July 3, 1872, from the Ordnance-Office, Washington, D. C., without accompanying letter or remark :

Alexander T. Loyd, 103, 105 South Canal street, Chicago, Illinois.
W. S. Smoot, (care of Remington & Sons,) Ilion, New York.
William Wheeler Hubbell, Philadelphia, Pennsylvania.
L. W. Wright, 90 Amity street, Brooklyn, New York.
John A. Terrell, Bloomfield, Nelson County, Kentucky.
Jacob Reese, (care of Fort Pitt Iron and Steel Works,) Pittsburgh, Pennsylvania.
John Robbins, Saint Louis, Missouri.
H. J. Allen, Arkadelphia, Arkansas.
Treadwell Cleveland, 27 Wall street, New York City, New York.
H. Burin, 83 South Fifth avenue, New York City.
Doctor Er R. McCabe, Leighton, Mahaska County, Iowa.
A. W. Kercheval, Romney, West Virginia.
Messrs. Jean François Pourrat and Antoine Mt. Thé, 109 Greene street, New York City, New York.
D. K. Swisher, Union City, Indiana.
E. Gulick, Rome, New York.
Doctor William Fields, 213 West Seventh street, Wilmington, Delaware.
C. F. Atwood, Hancock, Wisconsin.
Louis P. Elenterius, 91 Esplanade street, New Orleans, Louisiana.
John B. Sullivan, Davenport, Iowa.
Walter Jamieson, Brooklyn, New York.
Messrs. Alger & Co., Boston, Massachusetts.
West Point Foundry, Cold Spring, New York.
Messrs. Seyfert, McManus & Co., Reading, Pennsylvania.
Knapp's Fort Pitt Foundry Company, Pittsburgh, Pennsylvania.
H. Boker & Co., New York City, New York.
H. F. Mann, Pittsburgh, Pennsylvania.
Clifford Arrick, (care of S. S. Henkle, 215 F street, Washington, D. C.)
Norman Wiard, New York City, New York.
Nathan Thompson, (care of Donn Piatt, Washington, D. C.)
Doctor W. E. Woodbridge, (care of Henry Talmadge, 39 Pine street, New York City, New York.)
S. B. Dean, Alger's foundry, Boston, Massachusetts.
Charles Perley, New York City, New York.
T. W. Clarke, Wausau, Wisconsin.
Thomas C. Johnston, Abingdon, Virginia.
George Lines, Alma, Wabauensee County, Kansas.
S. E. Kierolf, Brownsville, Tennessee.
Charles F. Brown, (care of Inman Manufacturing Company, Warren, Rhode Island.)
James A. Ball, Cold Spring, New York.
Alban C. Stimers, 45 William street, New York City, New York.
George Armes, Chicopee, Massachusetts.
Risden Iron and Locomotive Works, San Francisco, California.

L. B. No. 12.]

ARMY BUILDING, NEW YORK,
July 13, 1872.

SIR: I have the honor to inform you that the board on heavy cannon desires to be informed what numbers and calibers of serviceable sea-coast cannon are on hand, including those in service. Also, that you will furnish the board with drawings of the Swedish 24-centimeter breech-loading cast-iron banded gun and of the Vavasseur steel gun.

Very respectfully, sir,

R. H. K. WHITELEY,
Colonel of Ordnance, President of Board.

The CHIEF OF ORDNANCE.

[Indorsement.]

[No. 32.]

Respectfully returned to Colonel R. H. K. Whiteley, president of board on heavy ordnance.

The following guns and mortars are on hand at the arsenals and forts, viz:

197 8-inch Rodman guns.

1,269 10-inch Rodman guns.

317 15-inch Rodman guns.

172 100-pounder Parrott guns.

81 200-pounder Parrott guns.

40 300-pounder Parrott guns.

20 10-inch Rodman sea-coast mortars.

59 13-inch Rodman sea-coast mortars.

The drawings asked for are herewith sent you.*

By order of Chief of Ordnance.

S. V. BENÉT,
Major of Ordnance.

ORDNANCE OFFICE, July 16, 1872.

L. B. No. 7.]

ARMY BUILDING, NEW YORK,
July 11, 1872.

SIR: I have the honor to request that the board organized under General Order No. 57, dated Adjutant-General's Office, June 28, 1872, be furnished with such information as can be obtained from the files of the Navy Bureau of Ordnance regarding the subject of the construction and tests of heavy ordnance, as found in the reports of Captains Simpson and Marvin regarding European systems.

Very respectfully, your obedient servant,

R. H. K. WHITELEY,
*Colonel of Ordnance and President Board.*CHIEF OF ORDNANCE, *United States Army,*
Washington, D. C.

No. 82.]

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, D. C., August 7, 1872.

SIR: Your communication of the 11th ultimo, asking for information from files of Navy Department regarding the subject of construction and tests of heavy ordnance, as found in the reports of Captains Simpson and Marvin, regarding European systems, is received; and in reply thereto I transmit herewith copies of the following reports,† viz: On Whitworth, Vavasseur, Parson's, Aboukoff gun, Frazer system, and Krupp's.

By order of the Chief of Ordnance.

Respectfully, your obedient servant,

S. C. LYFORD,
*Captain of Ordnance, Principal Assistant.*Colonel R. H. K. WHITELEY,
President of Board on Heavy Ordnance,
Corner Houston and Greene streets, New York City, N. Y.

* The drawings are not published herewith.

† By request the reports are omitted from publication.

L. B. No. 55.]

NEW YORK, August 21, 1872.

General A. B. DYER,

Chief of Ordnance, Washington, D. C. :

The board desire that the different models before it be photographed to accompany its report, the expense to be borne by the Department. Please telegraph authority.

R. H. K. WHITELEY,

Colonel of Ordnance, President of Board on Heavy Ordnance.

ORDNANCE OFFICE, WAR DEPARTMENT,
August 23, 1872.

Colonel R. H. K. WHITELEY,

President of Board on Heavy Ordnance, corner Houston and Greene streets, New York :

Purchase the photographs desired.

A. B. DYER,

Chief of Ordnance.

PAPERS SENT BY THE ADJUTANT-GENERAL.

L. B. No. 13.]

ARMY BUILDING, NEW YORK,
July 13, 1872.

SIR: The board on heavy cannon (convened by General Orders No. 57) respectfully requests that information be obtained for it from the Chief of Engineers as to the number and calibers of sea-coast guns required to arm permanent positions now completed, in process of construction, and projected. Also that there be obtained, for the information of the board, volumes v, vi, and vii, of the Minutes of the Proceedings of the Royal Artillery Institution, which are in the Library of Congress.

Very respectfully, sir,

R. H. K. WHITELEY,

Colonel of Ordnance, President of Board.

The ADJUTANT-GENERAL, U. S. A.,
Washington, D. C.

No. 81.]

ADJUTANT-GENERAL'S OFFICE,
Washington, August 8, 1872.

SIR: In reply to the inquiry upon the subject in your communication of the 13th ultimo, I have respectfully to communicate for your information the following indorsement of the Chief of Engineers:

"The total number of sea-coast guns required, in addition to those on hand, to arm platforms completed, projected, and in process of construction, are about as follows:

"Ten 20-inch guns.

"One thousand and seventy 15-inch smooth-bores and 12-inch rifles.

"Seven hundred and fifty 10-inch rifles and equivalent smooth-bore guns.

"Three hundred mortars of largest sizes.

"These numbers refer exclusively to guns for barbette positions, casemates not having been taken into consideration, as their modification has not yet been settled.

"Further modifications of the barbettes may reduce the number of 10-inch rifles and equivalent smooth-bore guns required, and, on the other hand, the number of 20-inch, 15-inch, and 12-inch rifled guns will be increased by projects of defense contemplated but not yet prepared."

With reference to your request for volumes v, vi, vii, of the Minutes of the Proceedings of the Royal Artillery Institution, I have respectfully to state, that finding no "Artillery-Service" journal, I have sent you by Adams's Express the designated volumes of the "Journal of the Royal United Service Institution," from the War Department library, which you will please return to this office when done with them.

Please acknowledge receipt, and state if this is not the work desired by the board.

Very respectfully, your obedient servant,

E. D. TOWNSEND,

Adjutant-General.

Colonel ROBERT H. K. WHITELEY, Ordnance Department,
President of Board on Heavy Cannon, Army Building, New York City.

CHARLES ALGER.

FROSTBURGH, MARYLAND, July 10, 1872.

No. 34.]

SIR: I beg leave to make some inquiry in regard to a proposed test of breech and muzzle loading ordnance, agreeable to your selection, for which, I understand by the daily papers, an appropriation has been made by Congress.

I would like to know what caliber of gun you would require for a model. In 1861, about the 10th of December, I had the honor to have a breech-loading cannon, carrying an 8-pound shot, tested at West Point, by order of the Ordnance Department, which I believe was the only breech-loading cannon that was ever tested at West Point by order of the Ordnance Department. It was tested at the time by Captain Benét, who I believe has since been promoted in the service. I beg to refer you to the report made by Captain Benét to the War Department.

Major Benton, who was in the Ordnance Office at the time, was pleased with the mechanical construction of the model I showed him, and he stated it was simpler and stronger in its construction than the celebrated "Armstrong gun."

I should be much pleased to send you a drawing of the gun, and would like to know what sized gun you would require in case you are disposed to have a trial made of my patent breech-loader, so I could send drawings for the same. I shall feel much honored if you will refer to Captain Benét's report in 1861. I think I can improve very much on the original model.

Hoping to hear from you, I am, very respectfully, your obedient servant,
CHARLES ALGER.

Hon. WM. W. BELKNAP,
Secretary of War, Washington, D. C.

[Indorsement.]

ORDNANCE OFFICE, July 16, 1872.

Respectfully referred to the board on heavy ordnance, accompanied by a copy of the report within referred to.

By order of the Chief of Ordnance.

S. V. BENÉT,
Major of Ordnance.

[Inclosure.]

WEST POINT, NEW YORK, December 14, 1861.

SIR: Having concluded a limited trial of Alger's breech-loading cannon, I have the honor to submit the following report:

The breech arrangement consists of a perforated steel sphere that closes the bottom of the bore, and is held in place by a perforated screw of great power, having a hemispherical concavity at the end that closes upon the sphere. The sphere is revolved in its place by means of a lever working on a circular slide that is screwed to the gun; the hole in the sphere being in the prolongation of the bore when the lever is perpendicular to it. By pulling the lever down parallel to the axis of the bore, the hole in the sphere is brought perpendicular to that axis, and the bottom of the bore is closed. The screw is worked by handles, and the slightest turn of it suffices to free the sphere, and permits its being worked by the lever. The entire arrangement can be easily understood from the inclosed sketch,* furnished by the inventor.

The gun is of cast iron, with a chamber 7 inches long and bore 39 inches long, rifled with 22 narrow grooves. The shot used were cast iron, cylindro-conoidal, with a band of soft metal (lead and tin) covering most of the cylindrical portion and projecting somewhat beyond the diameter of the shot. The cartridges were made of stout paper, cylindrical in form. An annular disk of sole-leather was used between the sphere and the cartridge, to act as a gas-check, and which remained at the bottom of the bore after the discharge.

In loading, a rammer 12 inches long was necessary to drive the shot, cartridge, and leather gas-check to their positions in the chamber. The lever was then drawn down, closing the breech with the sphere, and afterward a slight turn of the screw, with a tap or two of the mallet on the handles to bring it to its place, completed the loading. After being discharged a tap of the mallet on the handles turned the screw and relieved the sphere; the lever was then raised, bringing the hole in sphere in the prolongation of the bore.

A moist sponge was then thrust through the bore from the rear, and the gun was ready for another charge.

* Omitted from publication herewith.

Charge of powder, 10 to 12 ounces. Weight of shot, 6 to 8 pounds.

The object of the inventor being to show by the trial solely the working of the breech-arrangement, I will merely remark that in accuracy the firing did not compare favorably with that of some rifled guns now in service. This I attribute partly to the fact that the shot did not fill the chamber sufficiently to close the windage and take the grooves thoroughly in slugging through the bore. At the distance of a mile, the elevation needed was from $\frac{1}{2}^{\circ}$ to $1\frac{1}{4}^{\circ}$ greater than required for other rifled guns tried at this post.

To test the efficiency of the breech-arrangement, the screw and sphere being well oiled, 55 rounds were fired on the 4th instant. After the firing, upon examination the sphere was found black and coated with foulness; the screw-threads nearest the sphere were black, showing the escape of gas in considerable quantity. The working of the entire breech was, however, easy and satisfactory to the end of the firing. The gun was left in this condition, uncleaned, until the 10th instant, when, a supply of ammunition having been prepared, 29 rounds were fired, the breech-arrangement working easily. On the 11th instant 21 rounds were fired, with same results. In all, 105 rounds were fired without other cleaning than passing a wet sponge through the bore after each discharge; and during the firing, and at its termination, the working of the entire breech-apparatus was free, easy, and satisfactory. The screw and sphere being removed from the gun for examination, it was found that the breech-arrangement had fouled very considerably; the blackness extended along the threads of the screw nearly up to the handles; the sphere was perfectly black and foul, and considerable accumulation of foulness filled the vacant space between the sphere and the lower edge and end of the screw. But all this did not interfere with the easy and free working of the breech-arrangement. There was no perceptible yielding of any portion of the gun or breech, and the loading and handling were simple and easy to the end of the trial.

For rapidity of fire it was no equal to a muzzle-loading cannon, although a larger caliber of gun. By permitting the insertion of projectile and cartridge by hand, the gas-check being attached to the cartridge, might improve it in this regard.

Very respectfully, your obedient servant,

S. V. BENÉT,
Captain of Ordnance.

Brigadier-General J. W. RIPLEY,
Chief of Ordnance, Washington, D. C.

L. B. No. 27.]

ARMY BUILDING, NEW YORK,
July 18, 1872.

DEAR SIR: Your letter of the 10th instant to the Secretary of War has been received by the board on heavy cannon, and I am directed to write to you, inquiring whether you can construct a 12-inch rifle on the plan proposed, and if so, that you will submit plans and an estimate of the cost.

A copy of the report of the trial of your gun by Captain (now Major) S. V. Benét has also been received.

Very respectfully, sir,

C. E. DUTTON,
First Lieutenant Ordnance, Recorder.

CHAS. ALGER, Esq.,
Frostburgh, Maryland.

No. 63.] CHARLES ALGER, *Frostburgh, Maryland.*

Submitting model of a breech-loading gun of his invention. (No papers.) He was before the board July 25, 1872.

No. 83.]

FROSTBURGH, MARYLAND, August 6, 1872.

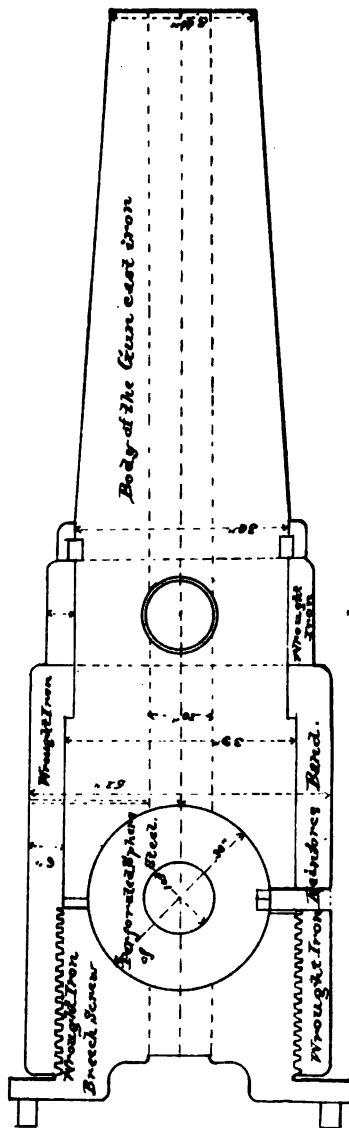
To the Board on Heavy Ordnance, Army Building, New York City:

GENTLEMEN: I beg leave to state I had hoped to have had the honor to forward with this a plan and estimate for a 10-inch rifle, using my patent breech-loading system. I have only applied to Messrs. Paulding Kemble & Co., of the West Point Foundry, Cold Spring, for a drawing and estimate of the cost of the construction of a 10-inch rifle. I regret to say I have only just received a letter from them, "declining to make an estimate, stating it would require expensive preparations which they neither have the time nor

Charles Alger.

Frostburg, Maryland.

Aug. 16th 1872.



means to undertake at present." I beg the board will give me further time to furnish a plan and estimate, and would much appreciate any suggestions as to who would be the best parties to apply to in this country or abroad for the construction of a 10-inch rifle. My idea of rifling a 10-inch rifle would be to have about 35 grooves, the grooves slightly wider than the lands, the corners of the grooves rounded off, with a gaining twist, beginning, say, at 0, and leave off at a turn of about 40 to 45 calibers, or 400 to 450 inches. The depth of the grooves, say, two-tenths of an inch. The projectile to have a soft casing, to be compressed into the grooves of the rifling, similar to the projectiles used by Krupp.

Would employ with my system a steel gas-check, as used in the Broadwell and Krupp ordnance. I presume Sir William Armstrong, or Messrs. Krupp, or other makers, could construct a breech-loading rifle according to my system of breech-loading. I am disposed to take the ground, my plan is much stronger and more simple than any system now used. As regards my patent, I should be glad to have the Ordnance Department construct a model rifle or trial 10-inch gun, according to my plan, which would be free of any royalty for the first one made. I wish to have my plan of breech-loading stand on its own merits.

Trusting the board will grant me more time for furnishing a plan and estimate, and that I may have the pleasure of hearing from them,

I am, very respectfully, your obedient servant,

CHAS. ALGER.

No. 92.]

CUMBERLAND, MARYLAND, *August 13, 1872.*

GENTLEMEN: I presume you have long since forgotten me, though my recent appearance at West Point as a member of the Board of Visitors may have resuscitated me in your recollection, if I have not passed entirely from your memory.

There is here an estimable young gentleman, Mr. Charles Alger, who is now managing successfully an iron-furnace, and I have become acquainted and much pleased with him. He has, he tells me, invented a breech-loading cannon, or new form of breech-loader, which he hopes will prove successful, but he fears somewhat that his invention will not attract sufficient attention without some expensive models and very full description, &c., and he has neither the means nor time to spare to give it the advantages of such outlays of money, time, and attention.

He is thoroughly aware that with your board no adventitious aids or patronage would be other than injurious, and that your standard is the true merit of the invention itself; but he thinks that the success might be forwarded in explaining and demonstrating the superiority of the gun, if he could have several made of different sizes, or rather some experiments made with the breech-pieces their sizes, proportionate to the size of gun, the sizes of various parts tried in different weights and proportions.

I simply write out of friendship to him, and because, if successful, the whole will inure to the benefit of the country and your own reputation, that if, in your own opinion, after testing the invention, you think the same kind of gun would answer, with some modifications, you will give him the benefit of such suggestions.

If I am in any way transgressing, or trespassing on your time, please excuse my ignorance, which is wholly to blame in the matter. He is not aware of my writing to you, and I would rather that he should not know it. But is there any impropriety in your suggesting improvements in his model, if it appears to be successful? I cannot see any.

With sincere regards and respect, I am your obedient servant,

GEO. A. THURSTON.

Colonel GEORGE W. GETTY, Lieutenant-Colonel H. G. WRIGHT, Lieutenant-Colonel T. T. S. LAIDLEY.

No. 93.]

FROSTBURGH, MARYLAND, *August 16, 1872.*

To the Board on Heavy Ordnance, Armory Building, New York:

GENTLEMEN: I beg leave to send you herewith a sketch of a 10-inch breech-loading rifle with my patent breech-loading system. In the construction of the gun, would make the body of the gun of cast iron and use a heavy wrought-iron reinforce band.

In shrinking on the band, would have the body of the gun in a vertical position and have a stream of water running through the piece of ordnance; after the band was shrunk on, would have the breech of the gun thoroughly annealed at a low temperature for forty-eight hours, and arrange to have it cooled as slowly as possible, so as to have the contraction of the reinforce band as uniform and just as possible. It is possible a

heavy breech-loading rifle might be constructed so as to employ a steel tube for the center of the gun and to receive the rifling, then shrink on the steel tube. The body of the gun might be made of aluminium bronze, an alloy of 90 parts pure copper and 10 parts of aluminium. Outside, of all, a heavy wrought-iron reinforce band or steel reinforce band, properly shrunk on.

Would use a projectile similar to Krupp's plan for breech-loaders, and a similar plan of rifling. Hoping the board will be able to adopt in their trials some American plans for breech and muzzle loading ordnance that will prove superior to those adopted by foreign governments, I have the honor to remain,

Very respectfully, your obedient servant,

CHARLES ALGER.

H. J. ALLEN.

H. O. No. 3, m.]

ARKADELPHIA, ARKANSAS, May 10, 1871.

DEAR SIR: Inclosed find a duplicate of patent issued to me for improvement in cannon. It has been suggested that material aid could be secured by applying to the Department, and I am quick to believe that you will lend me all the assistance your official position will permit in order to test the improvement. Satisfied, as I am, that it will bear a scientific and practical test, I am desirous that this should be done as soon as convenient. I am not conversant with the manner of proceeding, but will state to you what I wish, and then you can decide officially what should be done. I am a poor man and without sufficient means to carry out the enterprise, so I would like, after you have examined inclosed duplicate, and think it worthy of trial, to suggest what steps are necessary in order to get Government patronage to construct a gun and make trial thereof, wishing to be present at the construction and trial, &c. Will you please answer, &c.?

If your official duties are such that you cannot attend to this, please hand this to the proper person, and be kind enough to put me in communication with such party.

Respectfully, &c.,

H. J. ALLEN,
Arkadelphia, Arkansas.

SECRETARY OF WAR, U. S. A.,
Washington City, D. C.

[Inclosure.]

H. J. Allen's improvement in breech-loading cannon. Letters-patent No. 113,963, dated April 25, 1871.

To all whom it may concern:

Be it known that I, Hiram J. Allen, of Arkadelphia, in the county of Clark, and State of Arkansas, have invented a new and useful improvement in cannon; and I do hereby declare that the following is a full, clear, and exact description thereof, which will enable others skilled in the art to make and use the same, reference being had to the accompanying drawing, forming part of this specification, in which—

Figure 1 represents a side view, partly in section, of my improved cannon.

Figure 2 is a plan or top view of the same.

Figure 3 is a horizontal longitudinal section of the same.

Figure 4 is a detail horizontal longitudinal section of a modification of the same.

Figure 5 is a vertical transverse section of the same, the plane of section being indicated by the line *xx*, Fig. 1.

Similar letters of reference indicate corresponding parts.

My invention relates to cannon, and consists in a certain combination of parts, which will first be hereinafter described in connection with all that is necessary to a full understanding thereof, and then be clearly pointed out in the claim.

The barrel *A* is constructed as follows:

A suitable number of longitudinal bars, *a a*, is arranged to form the inner portion or bore of the gun. Around them are laid series of bands *b b*, which are arranged in layers in such manner that every outer layer covers the joints in the layer beneath. When the outermost layer of bands is put on, the collar *c*, carrying the trunnions *d*, is also applied. The bands are put on warm enough to shrink tight around the bars *a*, not, however, so tight that they would tend to break or injure said bars.

Cannon constructed on this plan are considerably lighter and stronger than those cast solid. The bands are either made of steel or wrought iron.

Cannon made on this plan are preferably to be constructed as breech-loaders, as in Fig. 3; but they may, by receiving a plug *B* at the breech-end, be readily made muzzle-loaders.

H. J. ALLEN, CANNON

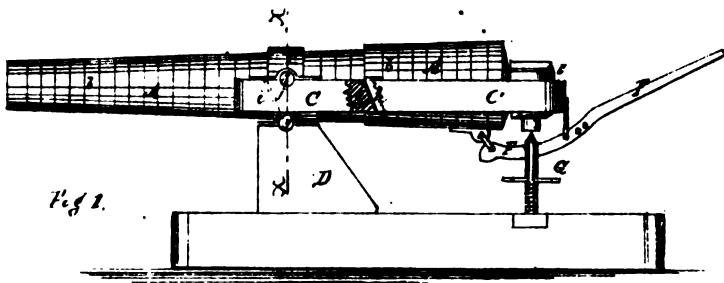


Fig. 1.

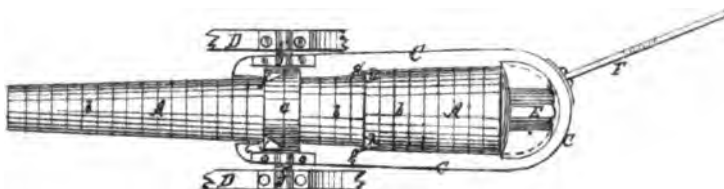


Fig. 2.

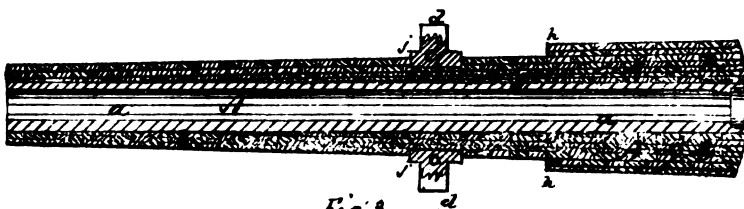


Fig. 3.

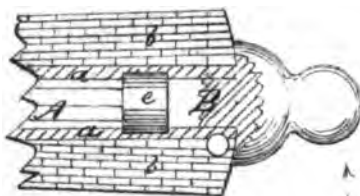


Fig. 4.

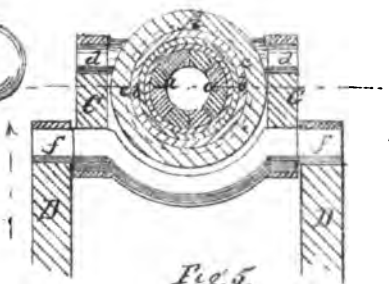
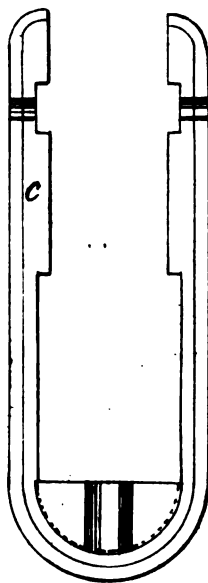
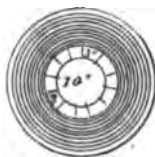
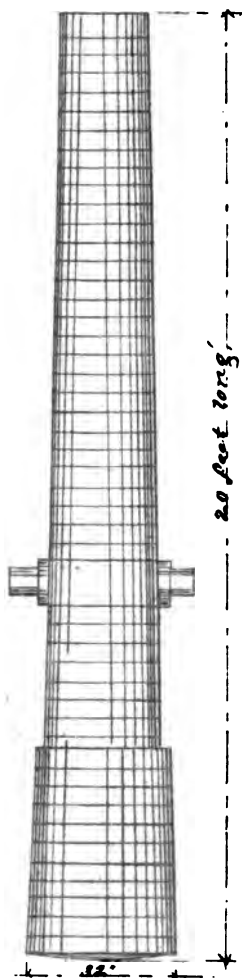


Fig. 5.

H. J. ALLEN.



The plug, B, should have a shoulder, *e*, fitting into a groove of the inner layers, *a*, as is clearly shown in Fig. 4.

The barrel, A, is, with its trunnions, hung in a U-shaped frame, C, which is pivoted by pins, *f*, to the gun-carriage, D.

In the back end of the frame C is fastened the breech-block E, which closes the bore, as in Fig. 2, and which has a longitudinal groove on its upper face, as shown.

A lever, F, is pivoted to the frame C, and has its front end connected with the barrel A. When the lever is swung down, the breech-end of the barrel will be raised above the block E, so that the bore will come in line with the channel in such block. In this position the gun will be ready for loading, the charge being placed upon the block and slid into the barrel. The lever is then swung down to close the breech-end, as in Fig. 1.

The range of the gun is regulated by a screw, G, which supports the rear end of the frame C.

On the frame C are, in rear of the trunnions, and on the inner side, formed inclined shoulders *g*, which serve to support inclined shoulders *h* formed on A when the gun is in the firing position. In front of the trunnions are, in the frame C, similar shoulders, *i*, to support shoulders *j* of the cannon, when the same is in the loading position. These shoulders, should the gun expand by incessant firing, will still support it, although the position will be slightly varied.

Having thus described my invention, I claim as new, and desire to secure by letters-patent—

The grooved breech-block E and pivoted barrel A, combined as described with the lever F and frame C, as aad for the purpose set forth.

H. J. ALLEN.

[The above letter with inclosure was referred to the board under cover of the letter of the Chief of Ordnance of July 8, 1872.]

[Telegram.]

H. O. No. 10.]

ARKADELPHIA, ARKANSAS, July 10, 1872.

Colonel R. H. K. WHITELEY,

President Board of Examination of Heavy Ordnance :

Attention called to my patent. Is my personal presence necessary? How long will the board sit? Answer.

H. J. ALLEN.

[Telegram.]

L. B. No. 54.]

ORDNANCE AGENCY, New York, July 11, 1872.

H. J. ALLEN, *Arkadelphia, Arkansas :*

Your plan is before the board. Your presence is optional, but not necessary.

C. E. DUTTON,
Recorder.

No. 58.]

ARKADELPHIA, ARKANSAS, July 16, 1872.

DEAR SIR: My personal presence being impossible at the present time, I think it advisable to submit the accompanying diagram and explanation, which may not suggest themselves by an inspection of the plans furnished you by the Chief of Ordnance, of my patent.

1st. Should my patent meet the favor of the board, I would suggest as a test piece the size in the diagram I send.

2d. The frame C may be made of two or more pieces, as indicated by the lines.

Suggestions: The object of using bars or staves is to get length, and smooth, even bore.

The principle of the patent is applicable to light or heavy guns.

Respectfully,

H. J. ALLEN.

Lieutenant C. E. DUTTON,

Secretary Board of Examiners of Heavy Ordnance, New York.

[Telegram.]

No. 59.]

ARKADELPHIA, ARKANSAS, July 24, 1872.

C. E. DUTTON,

(Care Board of Examiners of Heavy Ordnance:)

How long will board be in session? Can come if necessary.

H. J. ALLEN.

[Telegram.]

L. B. No. 33.]

ARMY BUILDING, NEW YORK,
July 25, 1872.H. J. ALLEN, *Arkadelphia, Arkansas:*

Your presence is unnecessary before the board.

C. E. DUTTON.

AMES'S WROUGHT-IRON GUNS.

No. 31.]

CHESTER, MASSACHUSETTS,
July 13, 1872.

SIR: I received from your office copy of General Order No. 57, at this place, forwarded from Washington a day or two ago. On behalf of Charlotte L. Ames, widow and administratrix of Horatio Ames, deceased, I desire to submit to this board an Ames 6"4 rifle, steel core, finished and ready for trial. The estate has three of these guns, and I am of opinion that they are the best of this caliber to be found in this country, and that they will do more work than any ten guns of like dimensions of any other manufacture. On my own behalf, I desire, also, if not excluded by the terms of the order, to submit my plans for shooting muzzle-loading rifles of every caliber and make. The Bureau is fully informed as to what they are, and can advise me as to the matter of exclusion!

Respectfully, your obedient servant,

CLIFFORD ARRICK.

CHIEF OF ORDNANCE,
War Department, Washington, D. C.

[Indorsement.]

ORDNANCE OFFICE, July 16, 1872.

Respectfully forwarded to the board on heavy ordnance for consideration and reply to the writer, who has been informed of this reference.

By order of the Chief of Ordnance.

S. V. BENÉT,
Major of Ordnance.

L. B. No. 24.]

ARMY BUILDING, NEW YORK,
July 17, 1872.

SIR: I am directed by the board on heavy cannon to inform you that the board does not regard a 6"4 rifle as classifiable with heavy guns within the meaning of General Orders, No. 57, Adjutant-General's Office, and therefore your proposition respecting three 6"4 rifles belonging to the estate of the late Horatio Ames does not come within the purview of the board. If, however, you have any plans to submit for the construction of similar guns of 10-inch and 12-inch caliber, the board would be pleased to receive them, with estimates of cost, and any other information you may be able to give concerning them. I am also directed to state that the subject of projectiles, *per se*, does not properly come before the board, but only as an essential feature of some system of gun-construction.

Very respectfully, sir,

C. E. DUTTON,
*First Lieutenant Ordnance, Recorder.*CLIFFORD ARRICK, Esq.,
Chester, Massachusetts.

L. B. No. 39.]

ARMY BUILDING, NEW YORK,
July 26, 1872.

SIR: I am directed to inform you that the board on heavy cannon has adjourned until the 7th proximo, by which time it is expected that all matter intended for its action will be before it.

Your obedient servant,

C. E. DUTTON,
*First Lieutenant Ordnance, Recorder.*CLIFFORD ARRICK, Esq.,
Chester, Massachusetts.

No. 76.]

WASHINGTON CITY, August 3, 1872.

SIR: I received the letter of your board of the 17th, in reply to mine addressed to the Bureau of Ordnance of the 13th ultimo; also your note of the 26th.

The 100-pounders to which I called the attention of the Bureau are the only "Ames guns" with "steel cores" ever made; and until they are subjected to trial none others are likely to be undertaken, as very certainly it would prove a useless expenditure of either public or private capital to continue the experiment in the higher calibers, unless these prove their superiority in some way in a high degree. My plans for shooting rifled cannon extend to those of any desired caliber, but do not "essentially," if at all, constitute a "feature of some," or indeed of any, "system of gun-construction." I hence conclude that, by the terms of your letter, as well as of General Order No. 57, I am excluded.

Feeling quite certain, however, that you will not recommend for trial any system of gun-construction "of 10-inch and 12-inch caliber," whereof the projectile is an "essential feature," I deem it important that those you do recommend be properly shotted at the trial, lest the whole performance, as it undoubtedly would, go absolutely for nothing.

It has been repeatedly affirmed by the ordnance authorities of the United States that the cast-iron cannon of the public service, known as the Rodman and Dahlgren systems, "when used as smooth-bores," are "perfectly reliable," and yet we have not had explained the apparent paradox that, "when used as rifles," they are "wholly unreliable," if not "absolutely worthless."

It will not be controverted that any number of Rodman or Dahlgren 9-inch, 10-inch, and 11-inch smooth-bore cannon, proving themselves in practice to be "perfectly reliable," necessarily demonstrates the proposition that, with cast iron, any series of such pieces may be produced of uniform manufacture, and hence possessing, practically, a uniform capacity for work. Equally plain is it that no series of pieces of any other system, fabricated of whatever material, can lay claim rationally to anything more than this.

A higher capacity, where a higher standard of material is used, may be, and undoubtedly is, attainable, but the problem of reproduction would still be unsolved, and, when favorably demonstrated, could give in the end only what we already possess, at an immense increase in cost.

The excellence of the cast-iron systems of Rodman and Dahlgren, when used as smooth-bores, is not only conceded by the intelligent ordnance-man, but their uniform endurance in service has inspired even the gunners of the Army and Navy with perfect and absolute confidence in both their efficiency and safety. It is not claimed that at every cast the same exact result is attainable, but experience has demonstrated that, under a careful manipulation, inspection, and proof, an armament of heavy cannon may be thus obtained, possessing practically a uniform capacity for work.

The advocates of the various "built-up" systems of heavy ordnance are contending rationally for merely a higher capacity than is possibly attainable with cast iron; and they do not hope in the end for more than successful production and reproduction of an indefinite series of pieces, possessing a uniform capacity for work. More would be absurd. While, therefore, by good management and good luck, they may present us with a single piece possessing an extraordinary capacity for work, experience has shown that the successful repetition of the performance is exceedingly problematical, and that the production of an armament, under any known method of manipulation, is reasonably impossible.

But another important inquiry arises in the case. These cast-iron systems may, and in my judgment do, possess a sufficient capacity for the work proposed, and with them the same velocities are attainable that could be were the pieces composed of perfect masses of homogeneous wrought iron or steel. This being so, what is to compensate for the immense difference in cost? No intelligent person would for a moment entertain the idea of substituting wrought-iron or steel 9-inch, 10-inch, and 11-inch guns to be used as smooth-bores, in place of the cast-iron Dahlgrens of the Navy, or of substi-

tuting in the Army 15-inch and 20-inch smooth-bores made of such material. Such pretension would be without reason, and unworthy of your consideration.

Having therefore a system of gun-construction wherein uniformity of manufacture, and hence a uniform capacity for work, are practical facts, the resulting quality, uniform endurance, justifies the conclusion that the system is not only efficient in action, but also, as affirmed, perfectly safe and reliable. We cannot, however, fail to perceive that the logical prerequisite here is the imposition in practice of a uniform system of work. Now, as no two charges of gunpowder, all else being the same, can be relied upon to develop the same intensity of pressure, a uniform imposition of work might be said to be impossible; but the variance from this source is known and within limits, and the maximum development furnishes a safe criterion for the establishment of a practically uniform system.

If with a 10-inch Dahlgren, with its spherical shot and service-charge, we have a maximum pressure of 40,000 pounds, we are within the easy capacity of the piece, and any variance to a lesser pressure would be in its favor, never exceeding the maximum; we hence have safety, and within limits always below the capacity of the piece. This is practically a uniform system of work.

The resistance of the projectile is of course practically uniform, and the conclusion, as demonstrated in action, is uniform endurance. We hence have, as the elements of success, uniform manufacture, uniform capacity, uniform work, uniform endurance, and hence a system "perfectly reliable."

What I propose to do is to guarantee the same conditions, and hence the same results, with these guns as rifles, and what I affirm is, that with none of the projectiles which the Government has in store is such a result possible. Both propositions are of easy demonstration. If such a discussion can be brought within the purview of your board, and I am permitted to submit my plans with a view to their adoption, I will do so with pleasure. I will also demonstrate that the results of practice in all the matters of success at the object, excel in a high degree anything attainable with any of these inferior and condemned devices.

I am, sir, very respectfully, your obedient servant,

CLIFFORD ARRICK.

Colonel R. H. K. WHITELEY,

President Heavy-Ordnance Board, Army Building, New York.

[No. 98.]

Copy of the reports of the boards on wrought-iron guns, manufactured by Horatio Ames, and correspondence relating thereto.

UNITED STATES ORDNANCE AGENCY, NEW YORK,

August 19, 1872.

Respectfully referred to the board on heavy ordnance, convened by General Orders No. 57, dated Adjutant-General's Office June 28, 1872, as bearing on the subject of wrought-iron gun construction.

S. CRISPIN,

Brevet Colonel United States Army, Major of Ordnance.

NAVY DEPARTMENT, *August 25, 1864.*

SIR: By direction of the President you are hereby appointed member of a board to meet at Bridgeport, Connecticut, on the 1st of September next, of which Major-General Gillmore, United States Army, is president, for the purpose of testing and inspecting a certain wrought-iron cannon with a view to determine its fitness for the United States service. You will proceed and report for this duty accordingly.

Very respectfully,

GIDEON WELLES,

Secretary of the Navy.

Commodore T. A. HUNT, U. S. N.,

Boston, Massachusetts.

ORDNANCE OFFICE, WAR DEPARTMENT,

Washington, August 23, 1864.

SIR: I transmit herewith a copy of an order from the President, directing that a board of officers meet at Bridgeport, Connecticut, on the 1st of September next, to inspect and test a cannon made by Mr. Ames, with the instructions of the Secretary of War thereon, designating you as the ordnance officer on said board; also directing

that all necessary ammunition for the trial be furnished. You will conform to this order and directions, and you are authorized to call on any arsenal for such ammunition as may be required to make such trials as the board may desire.

Respectfully, your obedient servant,

GEORGE D. RAMSAY,
Brigadier-General, Chief of Ordnance.

Major T. T. S. LAIDLEY,
Inspector of Cannon, &c., No. 710 Broadway, New York.

EXECUTIVE MANSION, August 21, 1864.

Mr. — Ames having constructed certain wrought-iron cannon of 7-inch caliber, which he desires to have inspected and tested with a view to determine their fitness for the United States service, it is ordered: *First.* That a board of officers, to consist of Major-General Gillmore as president of the board, a competent ordnance officer to be designated by the Secretary of War, and a competent officer to be designated by the Secretary of the Navy, shall be organized and meet at Bridgeport, Connecticut, on the 1st day of September next, with a view of *inspecting and testing* the aforesaid cannon, and determining their capacity and fitness for the United States service, with such tests and trials as they shall deem proper, and make report to the President of their opinion in respect to said cannon, and their value and fitness for the service.

Second. That the Ordnance Bureaus of the War and Navy Departments shall provide suitable shot, shells, and ammunition for making the aforesaid tests, and provide all the necessaries for a careful and fair test of the aforesaid cannon.

ABRAHAM LINCOLN.

In pursuance of the foregoing orders and subsequent orders from the Secretary of War postponing the meeting of the board until the 15th day of September, 1864, the board met, and the trials commenced at Bridgeport, Connecticut, on the day last mentioned. All the members of the board were present.

The gun to be tested was in readiness and suitably mounted. It is of wrought iron, weighs, according to Mr. Ames's statement, 19,400 pounds, is bored to a 7-inch caliber, and is rifled with a uniform twist of one turn in 35 feet.

The gun is built up from the cascable on the end of a long cylindrical port-bar. The end of this bar is first enlarged by welding pieces around it. It is then enlarged still further by placing two rings on the end, one over the other concentrically, and welding them there in succession. Against the end of the cylinder, thus increased to 28 inches in diameter, is welded a circular plate or disk, also 28 inches in diameter and 4 inches thick. This disk is composed of a center-piece 10 inches in diameter, surrounded by two concentric rings, one outside of the other, all *accurately* fitted together by turning. The bottom of the bore terminates against this disk. Upon this disk is welded a ring of 28 inches exterior diameter, 4 inches interior diameter, and 5 inches thick, compounded of three concentric rings, accurately fitted together by turning. The inner one is 10 inches in exterior diameter, and about six inches in thickness, so that its ends project on either side about half an inch beyond the faces of the other two rings. This is intended to secure a perfect weld next the bore and force out the slag.

Other compound rings, made in the same manner, are welded on, one after the other, until the gun is of the required length.

In making the compound rings for the small part of the gun between the trunnions and muzzle, the outer ring is omitted.

The gun remains in a horizontal position during this process of construction, and is handled by means of the bar projecting from the cascable.

The welding on of the disk and rings is done with a hammer worked horizontally by steam. A hammer, working vertically, is also used against the sides of the piece.

The inner ring of the compound rings is made from a block 6 inches by 10 inches by 10 inches by boring a hole 4 inches in diameter through it and turning off the corners. The fibers and laminae of the metal lie in planes at right angles to the axis of the gun. The center and outer rings are made like a tire by bending the bars and welding the ends together, thus placing the layers of the metal in cylindrical surfaces.

The trunnions are attached by being screwed into the sides of the piece 3 inches.

The grooves of the piece submitted to trial were found to be only fifty-eight thousandths of an inch in depth, which was not sufficient to confer a rotary motion upon the projectile with certainty, as was ascertained after a few trials. The board therefore adjourned to have the grooves cut to one-tenth of an inch in depth. This having been accomplished, the trials were resumed on the 27th day of September.

Considerable delay and many interruptions in the progress of the trials were occasioned by the want of suitable projectiles. Those of the Hotchkiss pattern, which have been officially proscribed for rifles of large caliber on account of their excessive strain upon the gun, were almost exclusively used. In weight they varied from 104 to 127

pounds. The powder used was what is known as No. 7 experimental powder, giving a pressure of 57,000 pounds per square inch in an 8-inch gun.

The charges were varied, increasing from 13 to 30 pounds, although it was frequently necessary to reduce the higher charges in order to accommodate the projectiles, from which the packing would often strip, or the cap break, even with comparatively low charges.

The proper instruments for determining the ranges of the shot, fired as they were over the water, were not received until the gun had been fired 600 times, and was much enlarged, giving a windage of more than three-tenths of an inch over the shot, and thereby causing a great loss of velocity and range.

The initial velocity of the shot fired with 19 pounds of powder was determined by means of the Vignotte chronoscope, when the gun had been fired 130 rounds. The velocity thus obtained was 1,490 feet.

Owing to the difficulty experienced from the fragments of the lead thrown from the shot *cutting* the wires prematurely, no efforts were made *subsequently* to obtain the velocities with other charges.

The greatest enlargement of the bore of the piece for the first one hundred rounds was one hundred and twenty-one thousandths of an inch, and at 15 inches from the bottom. After this enlargement was slight for each additional one hundred rounds until we had reached five hundred rounds and began to use 25-pound charges.

After the six hundredth round the enlargement exceeded three-tenths of an inch, which is the greatest measurement the star-gauge would record. This maximum enlargement extended for a distance of 3 inches along the bore, beginning at a point 20 inches from the bottom.

When the trials commenced the vent was in the metal of the gun, there being no vent-piece, and was so much enlarged by the first one-hundred rounds that it had to be bouched. A copper vent-piece, secured by a steel plug screwed in, was inserted and answered for the rest of the firing.

At about the five hundred and sixtieth round it was first discovered that the metal of the gun had been so much stretched laterally at the place of maximum interior enlargement that it was plainly visible in a swell on the outside, entirely encircling the piece. There was an increase of one-eighth of an inch in the exterior diameter at that place. This swell gradually diminished to nothing at a distance of 4 inches on either side of the circle of greatest enlargement.

When the gun had been fired but nineteen rounds, and before the grooves had been cut to the required depth of one-tenth of an inch, a crack on the inside, sufficiently wide and deep to be easily felt with a steel point, appeared, running a little more than half way round the bore, at a distance of 25 inches from the bottom. This crack was partially taken out of the grooves in rerifling the piece. Subsequent firing did not materially alter its appearance, or in *any way* enlarge it on the surface of the lands, while in the grooves it was *gradually* merged into or replaced by a series of holes or cavities, one in each groove, which appeared, one after the other, as the trials progressed. The first one that attracted attention grew wider and deeper, until, at the two hundredth round, it measured three-eighths of an inch in depth, and about 1 inch in width at the surface of the bore. After the three hundredth round it was 1½ inches deep, and had evidently penetrated entirely through the tube formed by the inner rings. Its progress was then apparently arrested, in a greater or less degree, by the metal of the middle rings. After the six hundredth round this cavity measured 1½ inches in depth, and about 1½ inches in width.

After the seven hundredth round these cavities measured as follows: The largest 1½ inches in depth, and 1½ inches wide. The others have enlarged slightly, but are apparently no deeper. They average about three-eighths of an inch deep and 1 inch wide. At the close of the trials, (seven hundredth round,) the vent-piece having been used six hundred times, the interior orifice of vent measured 0.25" in diameter. Radiating from the entrance of the vent-piece into the bore are three cracks, one in front and two in rear, and measuring in length 0.9" and 0.9" and 0.6" *respectively*, and about 0.8" deep.

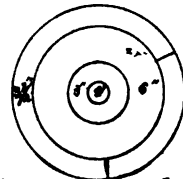
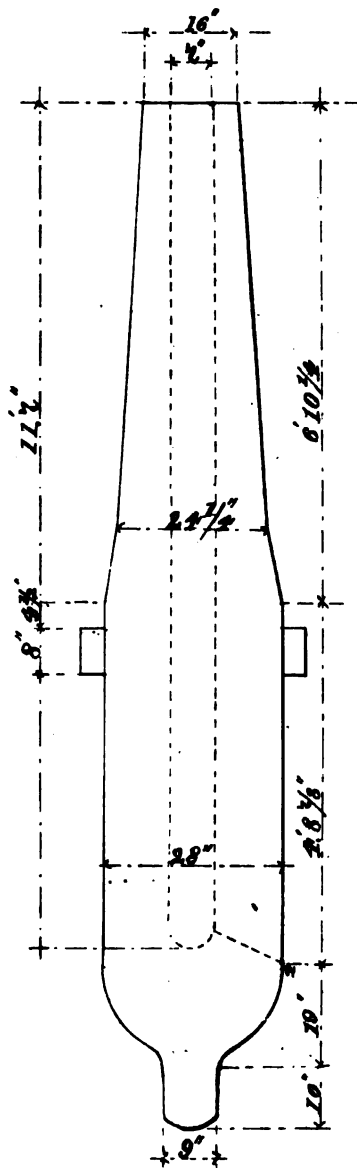
The edges of the lands are at present but slightly worn, and the rifling of the piece not much impaired.

It is the unanimous opinion of the board that Ames's wrought-iron guns possess, to a degree never before equalled by a cannon of equal weight offered to our service, the essential qualities of great lateral and longitudinal strength, and great powers of endurance under heavy charges; that they are not liable to burst explosively and without warning, even when fired under very high charges; and that they are well adapted to the wants of the service generally, but *especially* wherever long ranges and high velocity are required.

It is also the unanimous opinion of the board that Ames's 7-inch guns, of which he has now fifteen *nearly* finished, possess sufficient weight and strength to receive an 8-inch bore, and even greater, although not heavy enough for a 10-inch bore.

AMES' WROUGHT-IRON RIFLED GUN

BORE 7" DIA WEIGHT 19400 LBS.



Cross section of forging

Scale 2 1/2 feet to one inch

The board recommend that, in any future contracts for these guns, the limits of weight for certain calibers be fixed by the agent of the United States.

The board further recommend that the gun which they have tried be re-bored to 8 inches and rifled, and then submitted to another series of tests similar to those through which it has just passed, to be then cut up for examination.

Summary of firing.

Gun fired seven hundred times as follows:

380 times with 19 pounds No. 7 powder.
 114 times with 25 pounds No. 7 powder.
 65 times with 20 pounds No. 7 powder.
 20 times with 13 pounds No. 7 powder.
 12 times with 15 pounds No. 7 powder.
 6 times with 30 pounds No. 7 powder.
 5 times with 21 pounds No. 7 powder.
 5 times with 22 pounds No. 7 powder.
 4 times with 23 pounds No. 7 powder.
 3 times with 17 pounds No. 7 powder.
 3 times with 18 pounds No. 7 powder.
 2 times with 24 pounds No. 7 powder.
 37 times with 25 pounds cannon-powder.
 24 times with 20 pounds cannon-powder.
 6 times with 19 pounds cannon-powder.
 3 times with 15 pounds cannon-powder.
 3 times with 17 pounds cannon-powder.
 2 times with 13 pounds cannon-powder.
 6 times with 25 pounds cannon and mortar powder.

In addition to the foregoing, Mr. Ames states that he fired from the gun, before the board assembled, thirteen rounds as follows:

10 rounds with 13 pounds No. 7 powder.
 1 round with 16 pounds No. 7 powder.
 1 round with 20 pounds No. 7 powder.
 1 round with 25 pounds No. 7 powder.

The board have the honor to submit this report of its proceedings to this date, and have adjourned to await further instructions.

BRIDGEPORT, CONNECTICUT, *October 27, 1864.*

Q. A. GILLMORE,
Major-General Volunteers, President of Board.

T. A. HUNT,
Commodore, United States Navy.
 T. T. S. LAIDLEY,
Major of Ordnance.

THE PRESIDENT OF THE UNITED STATES,
Washington, D. C.

[NOTE.—The detailed target-records of firing the Ames gun are too voluminous for publication with this report, and are therefore omitted.]

FALLS VILLAGE, CONNECTICUT, *June 13, 1866.*

SIR: I have the honor to inclose herewith the report of the board on the wrought-iron 100-pounder guns manufactured by Horatio Ames at this place.

The board has been dissolved this day, as directed in your instructions of the 5th instant.

I am, very respectfully, your obedient servant,

T. A. HUNT,
Commodore and Inspector of Ordnance.

Commander H. A. WISE, U. S. N.,
Chief of Bureau of Ordnance, Navy Department, Washington, D. C.

FALL'S VILLAGE, CONNECTICUT, *June 13, 1866.*

SIR: In accordance with your order of the 5th instant, the board convened at this place as therein directed to examine the wrought-iron guns manufactured by Horatio Ames, and respectfully report as follows:

We commenced with the examination of the five guns that had been offered for

proof, four of which had been fired, and one, No. 2, was withdrawn by the agent of Mr. Ames before firing on account of a defect in the bore, and is now being bored out to be lined with steel. The bores of the remaining four guns No. 1, 3, 4, and 5, were thoroughly examined and impressions taken of the vents and different parts of the bore where defects were visible. The impressions indicated the same defects as had been previously found in the bore by Commodores Hitchcock and Hunt, at the time the guns were subjected to the powder-proof, the reports and impressions of which have been sent to the bureau. No other defects were discovered except in the cavity at the bottom of the bore of gun No. 4, which by inserting a hot iron rod was found to be four inches in depth.

The board are of opinion that guns can be made on Mr. Ames's plan without materially injuring the strength of the wrought iron; and when the welding is skillfully effected a stronger gun can be made in this way than in any other of which the board have any knowledge.

Experience has shown that all the guns made on this plan have not been welded perfectly, two 7-inch guns having been broken in firing ten rounds of 20 pounds of powder and a rifle projectile of 125 pounds, though they gave previously no evidence of defective welding.

Mr. Ames thinks that the experience gained in the manufacture of the guns heretofore made has enabled him to produce in these better guns than those above referred to.

Whether it is possible to make on this plan guns which can be relied upon in all cases is a question that the board do not feel competent to decide, at this state of development of the process, but they are of opinion that the importance of the subject, the necessity of introducing stronger rifle-guns than any now in service, warrants a fuller trial of the plan before pronouncing definitely against it.

The experiments with these wrought-iron guns have been thus far limited, and the only tests to which they have been subjected are those with very large charges.

It is not known what endurance they would show if fired with ordinary service-charges, the experience gained on such matters not being sufficient to enable us to judge with any degree of certainty from what they have undergone, what number of rounds they would endure if smaller charges were used.

The mode of manufacture of these guns is such that the strength of each gun depends entirely upon the skill with which it has been made, the perfection of the different welds, so that it is not possible to determine the strength or endurance of one gun from the knowledge of that of another gun of the same lot. The board cannot therefore pretend to decide upon the safety of the seven guns which have not been fired or tested in any manner.

One of the guns under consideration has been fired 220 times with a rifled projectile weighing 100 pounds and a charge of 20 pounds of No. 7 powder, without breaking—a much severer test than any gun in service is known to have withstood. What further endurance it may exhibit cannot be told without further experiment, though it is believed it may be fired many times with service-charges without much further alteration in its condition.

Before, however, the board should feel at liberty to recommend to the Bureau the reception of these guns, they deem it desirable that further trial should be made with them to test more thoroughly their endurance with such charges as will be fired in them in actual service.

Thus far it has not been found practicable to get a projectile that will stand the charges of powder used in these guns, so that the strain to which these guns have been subjected is an exceptional one, greater than that to which the gun would ever be called upon to bear, at least until an improvement is made in the projectiles; and though it has been proved that the guns of this lot thus far tried will withstand this strain, and the gun may be fired with these excessive charges, it is deemed of importance before making any recommendations in reference to their disposal that some gun of the lot, say No. 5, which has already been fired fifty rounds with 20 pounds of powder, should be fired one thousand rounds with 12 pounds of powder and 100-pound projectiles, and if it should stand the test, then to be fired further with 15-pound charges, and finally with 20-pound charges.

Very respectfully, we are, your obedient servants,

T. A. HUNT,
Commodore, United States Navy.
WM. ROGERS TAYLOR,
Captain, United States Navy.
T. T. S. LAIDLEY,
Brevet Colonel and Major of Ordnance.

Commander H. A. WISE,
Chief of Bureau of Ordnance, Washington, D. C.

BOSTON, MASSACHUSETTS, June 25, 1866.

SIR: Your letter of the 20th instant, in relation to the report of the board on the Ames guns, is received.

In reply to the question, "Does the board consider these wrought-iron 100-pounders suitable and safe guns in *every* respect; and does it recommend the Bureau to accept any or all of them for service in the Navy of the United States?" I would state that I would not consider those that have been fired with 20-pound charges (Nos. 1, 3, 4, and 5,) suitable and safe guns in *every* respect, nor would I recommend that those guns should be received for service in the Navy of the United States. The other guns that have not been fired, I can form no opinion of, except from the effect that the powder-proof has had on those that have been proved. As all of them have been forged from the same iron, and manufactured with the same care, and as all were free from any *visible* defects, I can see no reason why those that have not been subjected to proof should stand the powder-proof any better than those that have been proved, that is with 20-pound charges and a shell weighing 100 pounds. If, therefore, they are to endure any number of rounds of 20 pounds of powder and shell weighing 100 pounds, I could not recommend that they should be received for service in the Navy, nor do I consider them safe and suitable guns in every respect, for I do not believe they can endure many fires of these charges without showing some defects which would cause a doubt as to their efficiency and safety.

In explanation of the report of the board, I would state that one of these guns, No. 4, had been fired two hundred and twenty times with 20-pound charges and a shell weighing 100 pounds, ten times with 15-pound charges, and five times with 10-pound charges, making in all two hundred and thirty-five times, which, I think, tested the strength of the welding fairly, but the defects at the bottom of the bore were sufficient to condemn the gun. I wished to know then what effect less powder, say 12 pounds, the ordinary charge, would have on the bottom of the bore; therefore, gun No. 5, which had been fired fifty times with 20-pound charges and 100-pound shell, (which gave the welding a fair trial,) was recommended to be fired with 12-pound charges, to see the effect it would have on the bore. If the same defects began to be developed as in gun No. 4, after a series of fires, then the firing to cease and the gun to be condemned; but if the bore was not materially damaged, then more confidence might be had in the other guns. It is true that in welding such large masses of iron some of the weldings may not be perfect, although the greatest care may be used in their manufacture, and which cannot be seen when the gun is furnished; that is a risk that must necessarily be incurred in the manufacture of all wrought-iron guns. Two of the Army guns made by Mr. Ames burst by the blowing off of the breech, one at the first fire, the other at the ninth fire; since then, in the manufacture of guns for the Navy, more care has been observed in the heating and welding, and the manufacturer thinks that he has overcome that difficulty; it may be so, as thus far in the proof none have burst, although one of them (No. 4) has endured a severe trial. I thought, therefore, that if gun No. 5, which had been fired fifty times with 20-pound charges, stood the trial of a series of rounds with 12 pounds of powder without further material injury to the bore, some proof of a few heavy charges might be determined on to test the strength of the welding in the other guns, without injuring them for service. Some risk must be incurred in all guns, cast as well as wrought iron.

As these guns have been made by Mr. Ames at a great expense of time and money, and as the Government have no reliable rifled gun for heavy charges, I thought that, with the approval of the Bureau, a further trial of their strength and endurance would be more satisfactory to all concerned.

I have forwarded copies of your letter to Captain Taylor and Major T. T. S. Laidley.

I am, very respectfully, your obedient servant,

T. A. HUNT,
Inspector of Ordnance.

Commander HENRY A. WISE, U. S. N.,
Chief of Bureau of Ordnance, Washington, D. C.

NEWPORT, RHODE ISLAND, June 27, 1866.

SIR: I have received from Commodore Hunt a copy of your letter, dated 20th instant in reference to the report of the board on the Ames guns, requiring "an explicit and categorical reply" to questions propounded in your order to the board, dated June 5, 1866.

I have no hesitation in expressing my opinion that none of the 100-pounder rifled wrought-iron guns made by Mr. Ames, which have been subjected to proof, are safe guns for "service in the Navy of the United States." They have all been injured more or less by firing, and although it is possible or even probable that they would undergo

greater endurance, I could not advise the Bureau to place either of them on board ship, where, if they should burst, the consequences might be so deplorable.

An examination of two guns which burst, one at the first and the other at the ninth fire, inclines me to doubt the safety of any guns which have been made on this plan. I think it *possible* that guns may be made on Mr. Ames theory which will be perfectly strong and safe; two such guns have already sustained extraordinary tests, though one of them is so much injured that it may be expected to fly to pieces at any future discharge.

The great difficulty consists in obtaining uniformly good workmanship, whereby the welding may invariably be perfect. Practical workmen assure me that no *certainly* exists of attaining this result in all cases. Therefore, some guns may be perfectly strong while others, made by the same men, may prove worthless.

The guns which have not been fired were examined, and they present a fair appearance. Mr. Oliver Ames assured me that they have been made with greater care than some which have preceded them; but it is impossible for me to form any opinion concerning them, except the general one drawn from the examination and condition of those which have been fired. I cannot, therefore, advise the Bureau to accept them for "service in the Navy of the United States."

I am, sir, very respectfully, your obedient servant,

WM. ROGERS TAYLOR,
Captain and Inspector of Ordnance.

Commander H. A. WISE, U. S. N.,
Chief of Bureau of Ordnance, Washington, D. C.

NEW YORK ARSENAL, June 28, 1866.

SIR: I have the honor to acknowledge the receipt of a copy of your letter of the 20th instant, addressed to Commodore T. A. Hunt, asking for "an explicit and categorical reply" to the question, "Does the board consider these wrought-iron 100-pounders suitable and safe guns in *every* respect, and do they recommend the Bureau to accept any or all of them for service in the Navy of the United States?"

I am of the opinion that the answer given in the report of the board is as explicit as the information placed before them on the subject would warrant them in expressing.

If pressed for a further reply, I am constrained to say that I do not know whether the guns are suitable and safe in *every* respect or not, and therefore make no recommendation.

To the course of remarks given in the report of the board it may be proper to add that the impossibility of determining without trial whether one of these guns be safe or not, is the same as that which exists in the case of an ordinary musket-barrel. No one can venture to say that a musket-barrel is safe until it has been proved; much less can it be said of a gun of the size of these 100-pounders, that it is safe till it has been fired with large charges.

As the perfection of the weld of a musket-barrel is determined by firing it with proof-charges, and afterward finish boring it, so may it be possible to determine the strength of guns made like these 100-pounders in a similar manner.

But there are other qualities required in large guns besides *strength*, and whether these 100-pounders possess them can only be definitely settled by firing some of them a great number of times with the service-charges proposed to be used in them, and hence the recommendation of the board.

Very respectfully, your obedient servant,

T. T. S. LAIDLEY,
Brevet Colonel, Major of Ordnance.

Commander H. A. WISE, U. S. N.,
Chief of Bureau of Ordnance, Navy Department.

JAMES A. BALL.

H. O. No. 14.]

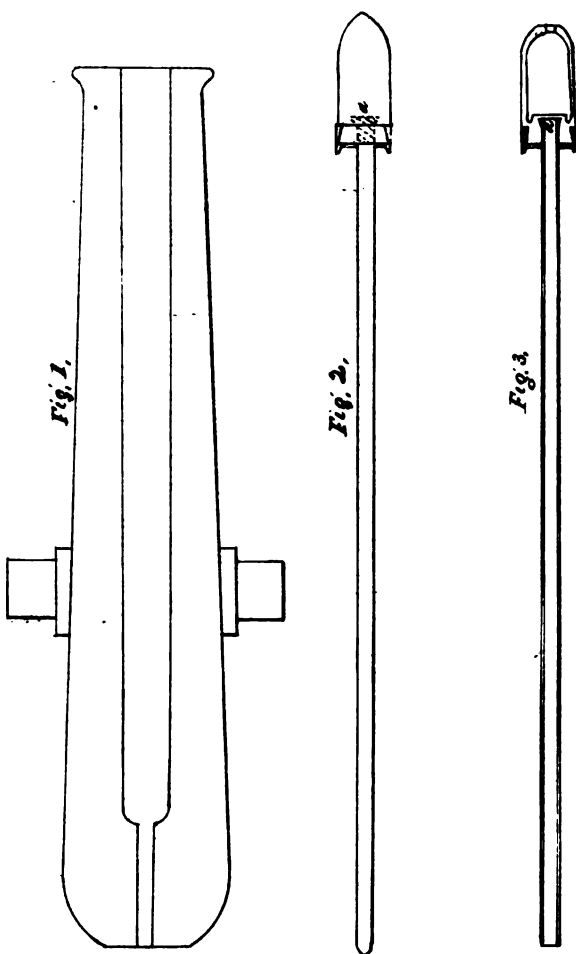
18 MAIDEN LANE, New York, July 9, 1872.

COLONEL: I have the honor to ask the particulars of time and place of meeting of the board on heavy ordnance matters, of which you are president.

I represent the interests of Mr. James Ball, of the Cold Spring Foundry, who has a model and drawings of a new gun and projectile to present before you; he having been notified from the Ordnance Bureau to do so. A 3-inch gun is now being made on his model.

Mr. Ball, I understand, is entitled to much of the credit of making the gun and pro-

JAMES A. BALL'S CANNON.



jectile of Parrott a practical success; and the plans for his new gun have been favorably received in the Ordnance Department, Washington.

Respectfully,

JAMES F. HALL.

Colonel R. H. K. WHITELEY,
President Ordnance Board, U. S. A.

No. 23.]

[James A. Ball. Papers withdrawn; see resolution of the board, proceedings of July 15, 1872.]

No. 61.]

JULY 24, 1872.

GENERAL: I have not been able to get away during the hours of your session, but inclose descriptions, &c.

I hope to have a $3\frac{1}{2}$ -inch shot and rod ready to submit to you on Monday; and if you are in session I will call on that day.

Respectfully,

JAMES F. HALL.

General R. H. K. WHITELEY, *President.*

No. 61.]

NEW YORK, July 15, 1872.

GENERAL: I have the honor to present herewith a model, together with description, of a rifled breech-loading cannon invented by me.

The simplicity of my invention, which I esteem as its important feature, enables it to be readily understood on examining the model.

A lever is attached to a pinion that moves a straight breech-piece backward or forward by a single motion. The breech being closed, one motion of the lever moves the breech-piece, so that the hole through it will coincide with the bore of the gun. The load is then inserted, the gun remaining all the time in battery. A counter motion of the lever moves back the breech-piece and the gun is ready to fire.

I claim simplicity in construction, and consequent non-liability of the gun to get out of order; that it is easily cleaned and is not liable to heat; that it may be fired with rapidity; that it may be easily disabled by drawing out a pin and removing the breech-piece; and that the gunners are not exposed while serving the piece.

I am, general, very respectfully, yours,

JAMES A. BALL,
By JAMES F. HALL,
His Attorney in fact.

Address: General James F. Hall, 18 Maiden Lane, New York.

General ROBERT H. K. WHITELEY,
President of Board for Experiments and Tests of Heavy Rifled Ordnance.

No. 61.]

NEW YORK, July 15, 1872.

GENERAL: I have the honor to present herewith a model, together with drawings and descriptions, of a rifled cannon and projectile for the same, invented by me.

Fig. 1 represents the cannon, which may be of any desired shape. The bore of the gun is prolonged through the breech, but of less diameter. The proportion of the diameter of the bore to the diameter of its prolongation through the breech, in a $3\frac{1}{2}$ -inch gun, is as $3\frac{1}{2}$ inches to $\frac{1}{8}$ -inch; the correct proportions for larger calibers will be ascertained by determining the preponderance of the shot as hereinafter explained. The bore through the breech should be made so that the rod attached to the shot will pass snugly but freely through it.

Fig. 2 represents the shot, which may be made of any of the ordinary shapes. To the rear, or base of the shot, is attached a rod or tube, which, where the gun is loaded, passes through the bore in the breech. The rod or tube should be a little longer than the bore of the gun. The rod is attached to the shot by being cast into it with a shoulder. (Fig. 2, a.)

With solid shots I propose to use iron or steel rods, and with shells tubes. The

tubes may be filled with explosive materials, like rockets or Roman candles, and used for signals as well as to add to the velocity. The tubes are cast into the shells in the manner that the rods are cast into the shots. (Fig. 3, a.)

The preponderance of the projectile should be in favor of the shot or shell at its junction with the rod or tube.

The cartridge may be of ordinary cartridge or of compressed powder, but so arranged that the rod or tube may pass through it. In loading, it is slipped on the rod until it meets the shot; the rod is then inserted into the gun, and instead of ramming the ball home from the muzzle it may be pulled home by the rod as soon as the rod has passed through the bore in the breech to the rear of the gun, thus saving the gunners from exposure.

The rear of the cartridge may be furnished with a disk of copper or other material, so as to more thoroughly prevent the escape of gases through the bore in the breech.

I do not believe that there will be any necessity for this disk, as the result of my own experiments shows that there is practically no escape of gases through the bore in the breech. The operation is very much the same as that of a piston-rod in an engine.

I claim that there will be a more complete combustion of the powder on account of the increase in the area of the surface in the cartridge; and that notwithstanding the additional weight of the projectile on account of the rod or tube, the initial velocity of the projectile will be greater; that the rod or tube will correct the acceleratory motion of the shot, and will prevent it from tumbling; that the aim will be more exact, and the range and penetration greater; that less elevation will be required; and that when the shot strikes its object it will not glance off, but will be held to its work until its force is expended.

I am, general, very respectfully, yours,

JAMES A. BALL,
By JAMES F. HALL,
His Attorney in fact.

Address: General James F. Hall, 18 Maiden Lane, New York.

General ROBERT H. K. WHITELEY,
President of Board for Experiments and Tests of Heavy Rifled Ordnance.

BOCHUM MINING AND CAST-STEEL MANUFACTURING COMPANY.

H. O. No. 7.]

OFFICE OF HERMANN BOKER & Co., & Co.,
New York, July 2, 1872.

COLONEL: Agreeably to your verbal instructions we telegraphed to-day to the Bochum Mining and Cast-Steel Manufacturing Company, Bochum, Prussia:

"How soon and at what price can you deliver 12-inch caliber guns? Ordnance board in session this month to receive specifications."

And to Horstman & Co., bankers, London:

"Get from Vavasseur, Bear Lane, drawing and specification of 12-inch cast-steel breech and muzzle loading rifled-guns. Express immediately. Get Stevens's books. Express immediately."

And also telegraphed to Horstman & Co. on the 27th ultimo:

"Receive and pay Stevens, London, 17 Hamilton street, for books for United States."

Awaiting replies, we remain yours, respectfully,

HERMANN BOKER & CO.

Colonel S. CRISPIN,

Major of Ordnance, corner Greene and Houston Streets, City.

[Indorsement.]

UNITED STATES ORDNANCE AGENCY,
New York, July 10, 1872.

Respectfully referred to the board on heavy ordnance, convened by General Orders No 57, dated June 28, 1872.

S. CRISPIN,
Brevet Colonel, U. S. A., Major of Ordnance.

No. 17.]

OFFICE OF HERMANN BOKER & Co.,
New York, July 9, 1872.

COLONEL: We have received a dispatch from the Bochum Mining and Cast-Steel Manufacturing Company, Bochum, Prussia, with offer of cast-steel rifled, 12-inch cali-

ber, muzzle-loader, weight of barrel about 33,000 pounds, weight of armor rings about 36,000 pounds, total weight about 69,000 pounds, to be delivered at European shipping port, within one year from date of order. Specifications are now under way and will be duly presented.

Yours, respectfully,

HERMANN BOKER & CO.

Colonel S. CRISPIN,

Major of Ordnance, Greene and Houston Streets, City.

[Indorsement.]

UNITED STATES ORDNANCE AGENCY,
New York, July 10, 1872.

Respectfully referred to the board on heavy ordnance, convened by General Orders No. 57, dated June 23, 1872.

S. CRISPIN,

Brevet Colonel, U. S. A., Major of Ordnance.

H. O. No. 8.]

OFFICE OF HERMANN BOKER & CO.,
New York, July 10, 1872.

COLONEL: We have the pleasure to hand tracing of cross-section of the shell for Bochum cast-steel 6 pound (Prussian standard) rifled gun, which we sent to you some time ago.

In regard to your inquiries as to the steel-lined Rodman guns, we have received the following notes from the Bochum Mining and Cast-Steel Manufacturing Company. In the absence of specifications of the guns to be changed in that manner no definite methods can be proposed, but the following general observations are respectfully submitted:

"The system of changing cast-iron smooth-bores into steel-lined rifled breech-loaders has been abandoned in England, after thorough and manifold trials, and has not been tried in Prussia.

"The cast-steel lining for muzzle-loaders appears to be more feasible, and unless the steel barrels are to be inserted at the works it would be advisable to furnish them bored out and turned from the rough to a nearly finished state. This seems necessary because the turning and boring are the only means to ascertain whether the steel barrels are free from flaws, and barrels in the rough could only be delivered at the risk of the purchaser.

"The Bochum company offers to make one or a few of these barrels experimentally, and incidentally proposes as most convenient for the present manufacturing arrangements to furnish barrels of the following dimensions, to wit: For 10-inch caliber, smooth-bores, rifles of 21 centimeters caliber; for 8-inch caliber, smooth-bores, rifles of 15 centimeters caliber.

"The above metrical dimensions are the Prussian standard, and are worked at present at the Bochum works."

Yours, respectfully,

HERMANN BOKER & CO.

Colonel S. CRISPIN,

Major of Ordnance, corner Greene and Houston Streets, City.

[Indorsement.]

UNITED STATES ORDNANCE AGENCY,
New York, July 10, 1872.

Respectfully referred, together with its inclosures, to the board on heavy ordnance, convened by General Orders No. 57, dated Adjutant-General's Office, June 28, 1872.

S. CRISPIN,

Brevet Colonel, U. S. A., Major of Ordnance.

L. B. No. 8.]

OFFICE OF UNITED STATES ORDNANCE AGENCY, &C.,
New York City, July 11, 1872.

SIR: I have the honor to request that a copy of the record of the mechanical tests

made by General Rodman with a cast-steel cylinder, fabricated by the Bochum Manufacturing Company, be furnished for the information of the board on heavy ordnance. Very respectfully, your obedient servant,

R. H. K. WHITELEY,
Colonel of Ordnance, and President of Board.

CHIEF OF ORDNANCE, UNITED STATES ARMY,
Washington, D. C.

[Indorsement.]

Respectfully returned to Colonel R. H. K. Whiteley, president of the board on heavy rifled ordnance, with the report asked for.

By order of the Chief of Ordnance.

S. V. BENÉT,
Major of Ordnance.

ORDNANCE OFFICE, July 12, 1872.

No. 22.]

[Inclosures.]

I.—Table showing extension, restoration, and permanent set per inch in length caused by the undermentioned weights per inch of section, applied gradually, acting on a solid cylinder 10 inches long and 1.128 inches in diameter, cut from the exterior of a trial cylinder 4 feet long and 2 feet in diameter, of hammered cast steel, made by the Bochum Mining and Cast Steel Company, Bochum, Prussia.

Weight per square inch of section— pounds.	Extension per inch in length.	First difference.	Restoration per inch in length.	First difference.	Permanent set per inch in length.	First difference.	Weight per square inch of section— pounds.	Extension per inch in length.	First difference.	Restoration per inch in length.	First difference.	Permanent set per inch in length.	First difference.
1,000	.00003	.....	.00003	.....	.....	.....	30,000	.00891	.00068	.00109	—	.00012	.00782
2,000	.00007	.00004	.00007	.00004	.....	.....	31,000	.01031	.00140	.00100	—	.00009	.00931
3,000	.00010	.00003	.00010	.00003	.....	.....	32,000	.01150	.00119	.00111	—	.00011	.01039
4,000	.00012	.00002	.00012	.00002	.....	.....	33,000	.01266	.00116	.00118	—	.00007	.01148
5,000	.00016	.00004	.00016	.00004	.....	.....	34,000	.01498	.00232	.00120	—	.00002	.01378
6,000	.00018	.00002	.00018	.00002	.....	.....	35,000	.01618	.00120	.00220	—	.00100	.01398
7,000	.00022	.00004	.00022	.00004	.....	.....	36,000	.01848	.00230	.00040	—	.00180	.01808
8,000	.00023	.00001	.00023	.00001	.....	.....	37,000	.01968	.00120	.00040	—	.00000	.01928
9,000	.00027	.00004	.00027	.00004	.....	.....	38,000	.02198	.00230	.00120	—	.00080	.02078
10,000	.00033	.00006	.00033	.00006	.....	.....	39,000	.02368	.00170	.00150	—	.00030	.02218
11,000	.00038	.00005	.00038	.00005	.....	.....	40,000	.02598	.00230	.00070	—	.00080	.02528
12,000	.00039	.00001	.00039	.00001	.....	.....	41,000	.02818	.00220	.00100	—	.00030	.02718
13,000	.00041	.00002	.00041	.00002	.....	.....	42,000	.03148	.00330	.00140	—	.00040	.03008
14,000	.00044	.00003	.00044	.00003	.....	.....	43,000	.03398	.00250	.00160	—	.00020	.03238
15,000	.00049	.00005	.00048	.00004	.00001	.....	44,000	.03708	.00310	.00150	—	.00010	.03558
16,000	.00050	.00001	.00049	.00001	.00001	.....	45,000	.03928	.00220	.00170	—	.00020	.03758
17,000	.00053	.00003	.00051	.00002	.00002	.00001	46,000	.04300	.00372	.00120	—	.00010	.04120
18,000	.00056	.00003	.00054	.00003	.00002	.00000	47,000	.04528	.00228	.00100	—	.00080	.04428
19,000	.00064	.00008	.00061	.00007	.00003	.00001	48,000	.05038	.00510	.00100	—	.00000	.04938
20,000	.00072	.00008	.00062	.00001	.00010	.00007	49,000	.05518	.00480	.00190	—	.00090	.05328
21,000	.00083	.00011	.00067	.00005	.00016	.00006	50,000	.05982	.00464	.0020	—	.00010	.05782
22,000	.00089	.00006	.00057	—	.00010	.00032	51,000	.06448	.00466	.00210	—	.00010	.06238
23,000	.00169	.00080	.00078	—	.00021	.00091	52,000	.07028	.00580	.00200	—	.00010	.06808
24,000	.00242	.00073	.00036	—	.00042	.00206	53,000	.07688	.00660	.00230	—	.00010	.07458
25,000	.00370	.00124	.00099	—	.00063	.00271	54,000	.08428	.00740	.00240	—	.00010	.08188
26,000	.00426	.00056	.00098	—	.00001	.00328	55,000	.09298	.00870	.00250	—	.00010	.09048
27,000	.00536	.00110	.00095	—	.00003	.00441	56,000	.10438	.01140	.00260	—	.00010	.10178
28,000	.00603	.00067	.00103	—	.00008	.00500	57,000	.11908	.01470	.00270	—	.00010	.11638
29,000	.00823	.00220	.00097	—	.00006	.00726	58,000	.12498					.00056

The strain was then taken off, and on being applied again the specimen broke before 58,000 pounds was reached.

II.—Table showing the extension, restoration, and permanent set per inch in length caused by the undermentioned weights per square inch of section acting on a solid cylinder 10 inches long and 1.128 in diameter, cut from near the axis of a trial cylinder of hammered cast steel, made by the Bochum Mining and Cast Steel Company, Bochum, Prussia.

Weight per square inch of section— pounds.	Extension per inch in length.	First difference.	Restoration per inch in length.	First difference.	Permanent set per inch in length.	First difference.	Weight per square inch of section— pounds.	Extension per inch in length.	First difference.	Restoration per inch in length.	First difference.	Permanent set per inch in length.	First difference.
1,000	00000	—	—	—	—	—	28,000	01092	00146	00097	—	00000	00095
2,000	00000	—	—	—	—	—	29,000	01265	00173	00100	—	00003	01163
3,000	00001	—	00001	—	—	—	30,000	01415	00150	00070	—	00000	01345
4,000	00002	00001	00002	—	00001	—	31,000	01665	00250	00100	—	00030	01565
5,000	00002	00000	00002	—	00000	—	32,000	01865	00200	00030	—	00030	01735
6,000	00003	00001	00003	—	00001	—	33,000	02045	00180	00160	—	00030	01885
7,000	00003	00000	00002	—	00001	—	34,000	02255	00210	00140	—	00020	02115
8,000	00003	00000	00002	—	00000	—	35,000	02475	00220	00110	—	00030	02365
9,000	00004	00001	00003	—	00001	—	36,000	02715	00240	00120	—	00010	02595
10,000	00005	00001	00004	—	00001	—	37,000	03175	00460	00360	—	00240	02815
11,000	00007	00002	00006	—	00002	—	38,000	03245	00070	00150	—	00210	03095
12,000	00008	00001	00007	—	00001	—	39,000	03535	00290	00060	—	00090	03475
13,000	00008	00000	00007	—	00000	—	40,000	03855	00320	00170	—	00110	03685
14,000	00009	00001	00008	—	00001	—	41,000	04205	00350	00190	—	00020	04015
15,000	00009	00000	00008	—	00000	—	42,000	04505	00300	00190	—	00000	04315
16,000	00011	00002	00010	—	00002	—	43,000	04865	00360	00200	—	00010	04665
17,000	00011	00000	00010	—	00000	—	44,000	05485	00620	00200	—	00000	05265
18,000	00012	00001	00011	—	00001	—	45,000	05935	00450	00210	—	00010	05725
19,000	00012	00000	00011	—	00000	—	46,000	06495	00560	00210	—	00000	06285
20,000	00015	00003	00013	—	00002	—	47,000	07065	00370	00210	—	00000	06855
21,000	00018	00003	00009	—	00004	—	48,000	07773	00710	00220	—	00010	07555
22,000	00025	00007	00014	—	00005	—	49,000	08623	00850	00210	—	00010	08415
23,000	00030	00040	00089	—	00075	—	50,000	09583	00940	00240	—	00020	09335
24,000	00044	00114	01122	—	00033	—	51,000	10815	01250	00260	—	00030	10555
25,000	00668	00124	00083	—	00441	—	52,000	12915	02100	00310	—	00050	12605
26,000	00799	00131	00093	—	00119	—	53,000	15765	02850	00230	—	00020	15535
27,000	00946	00147	00097	—	00004	—	53,400				—		

And the specimen broke; diameter at point of rupture .995; length of specimen 12.2.

III.—Table showing the extension, restoration, and permanent set per inch in length caused by the under-mentioned weights per square inch of section, acting gradually on a solid cylinder 10 inches in length and 1.128 inches in diameter, cut from the lower end and perpendicular to the axis of a trial cylinder of hammered cast steel, made by the Bochum Mining and Cast-Steel Company, Bochum, Prussia.

Weight per square inch of section—pounds.	Extension per inch in length.	First difference.	Restoration per inch in length.	First difference.	Permanent set per inch in length.	First difference.	Weight per square inch of section—pounds.	Extension per inch in length.	First difference.	Restoration per inch in length.	First difference.	Permanent set per inch in length.	First difference.
1,000	0.0002	.....	0.0002	.....			26,000	0.0534	0.0117	0.0094	0.0009	0.0440	0.0108
2,000	0.0005	0.0003	0.0005	0.0003	0.0003	0.0003	27,000	0.0655	0.0121	0.0094	0.0000	0.0561	0.0121
3,000	0.0008	0.0003	0.0008	0.0003	0.0003	0.0003	28,000	0.0787	0.0138	0.0093	0.0001	0.0684	0.0138
4,000	0.0011	0.0003	0.0011	0.0003	0.0003	0.0003	29,000	0.0910	0.0123	0.0106	0.0013	0.0804	0.0110
5,000	0.0016	0.0005	0.0016	0.0005	0.0005	0.0005	30,000	0.1062	0.0153	0.0098	0.0006	0.0964	0.0160
6,000	0.0020	0.0004	0.0018	0.0002	0.0002	0.0002	31,000	0.1208	0.0148	0.0110	0.0012	0.1098	0.0134
7,000	0.0024	0.0004	0.0022	0.0002	0.0002	0.0002	32,000	0.1318	0.0110	0.0111	0.0001	0.1287	0.0129
8,000	0.0031	0.0007	0.0027	0.0005	0.0004	0.0002	33,000	0.1577	0.0259	0.0130	0.0019	0.1447	0.0160
9,000	0.0036	0.0005	0.0031	0.0004	0.0005	0.0001	34,000	0.1757	0.0190	0.0100	0.0030	0.1657	0.0210
10,000	0.0041	0.0005	0.0035	0.0004	0.0006	0.0001	35,000	0.1977	0.0220	0.0140	0.0040	0.1837	0.0180
11,000	0.0044	0.0003	0.0033	0.0002	0.0011	0.0005	36,000	0.2167	0.0190	0.0150	0.0010	0.2017	0.0180
12,000	0.0047	0.0003	0.0036	0.0003	0.0011	0.0000	37,000	0.2387	0.0220	0.0140	0.0010	0.2247	0.0230
13,000	0.0053	0.0006	0.0041	0.0005	0.0012	0.0001	Remained in two hours without strain upon it.						
14,000	0.0059	0.0006	0.0047	0.0006	0.0012	0.0000	38,000	0.2337	0.0000	0.0140	0.0000	0.2247	0.0000
15,000	0.0059	0.0000	0.0047	0.0000	0.0012	0.0000	39,000	0.2347	0.0000	0.0140	0.0000	0.2247	0.0000
16,000	0.0061	0.0002	0.0049	0.0002	0.0012	0.0000	40,000	0.2387	0.0000	0.0140	0.0000	0.2247	0.0000
17,000	0.0064	0.0003	0.0051	0.0002	0.0013	0.0001	41,000	0.2427	0.0046	0.0170	0.0030	0.2257	0.0010
18,000	0.0072	0.0008	0.0057	0.0006	0.0015	0.0002	42,000	0.2587	0.0160	0.0180	0.0010	0.2407	0.0150
19,000	0.0072	0.0000	0.0058	0.0001	0.0016	0.0001	43,000	0.2937	0.0090	0.0090	0.0090	0.2797	0.0030
20,000	0.0079	0.0007	0.0057	0.0001	0.0022	0.0006	44,000	0.3237	0.0350	0.0180	0.0090	0.3057	0.0260
21,000	0.0104	0.0025	0.0070	0.0013	0.0034	0.0012	45,000	0.3817	0.0580	0.0190	0.0010	0.3627	0.0270
22,000	0.0157	0.0053	0.0068	0.0002	0.0089	0.0030	46,000	0.4247	0.0430	0.0180	0.0010	0.4067	0.0440
23,000	0.0230	0.0073	0.0071	0.0003	0.0159	0.0075	47,000	0.4857	0.0100	0.0120	0.0060	0.4737	0.0670
24,000	0.0326	0.0089	0.0089	0.0018	0.0237	0.0078	Broke between 47,000 and 48,000 pounds. Diameter at point of rupture 1.080. Broke near the middle.						
25,000	0.0417	0.0091	0.0085	0.0004	0.0332	0.0095							

IV.—Table showing the extension, restoration, and permanent set per inch in length caused by the repeated application of the under-mentioned weights per square inch, acting gradually on a solid cylinder 10 inches long and 1.128 inches in diameter, cut from the exterior of a trial cylinder of hammered cast steel, made by the Bochum Mining and Cast-Steel Company Bochum, Prussia.

Weight per square inch of section—pounds.	Number of repetitions.	Extension per inch in length.	First difference.	Restoration per inch in length.	First difference.	Permanent set per inch in length.	First difference.
41,250 pounds, $\frac{3}{4}$ breaking weight of a similar specimen.	1	.03225	.....	.0017	.....	.03055	.....
	10	.03615	.00390	.0016	— .0001	.03455	.00400
	20	.03615	.00000	.0015	— .0001	.03465	.00010
	40	.03615	.00000	.0015	— .0000	.03465	.00000
	70	.03615	.00000	.0013	— .0002	.03485	.00020
After seventeen hours' rest.....						.03465	.00020
	100	.03615	.00000	.0013	.0000	.03485	.00020
	150	.03615	.00000	.0013	.0000	.03485	.00000
After sixteen hours' rest.....						.03475	.00010
	200	.03615	.00000	.0014	.0001	.03475	.00000
45,000 pounds, 9-11 breaking weight of a similar specimen.	1	.03625	.00010	.0014	.0000	.03485	.00010
After sixteen hours' rest.....	100	.03625	.00000	.0014	.0000	.03485	.00000
						.03475	.00010
	200	.03625	.00000	.0015	.0001	.03475	.00000
50,000 pounds, 10-11 breaking weight of a similar specimen.	1	.05245	.01620	.0021	.0006	.05035	.01560
	2	.05255	.00010	.0018	— .0003	.05075	.00040
	3	.05295	.00040	.0021	.0003	.05085	.00010
	4	.05315	.00020	.0022	.0001	.05095	.00010
	5	.05315	.00000	.0022	.0000	.05095	.00000
	10	.05365	.00050	.0021	— .0001	.05155	.00060
	30	.05495	.00130	.0021	.0000	.05285	.00130
After sixteen hours' rest.....						.05285	.00000
	60	.05495	.00000	.0021	.0000	.05285	.00000
	110	.05495	.00000	.0021	.0000	.05285	.00000
	200	.05495	.00000	.0021	.0000	.05285	.00000
55,000 pounds, breaking weight of a similar specimen.	1	.05505	.00010	.0022	.0001	.05285	.00000
After sixteen hours' rest.....	2	.05505	.00000	.0021	— .0001	.05285	.00010
						.05295	.00000
	3	.05495	.00010	.0020	— .0001	.05295	.00000

Broke at the ninth repetition, at the shoulder.

From the above table it appears that the repeated application of the same strain could only extend the specimen a certain distance, the particles having assumed a permanent re-adjustment requiring a greater strain to alter it.

V.—Table showing the compression, restoration, and permanent set per inch in length caused by the under-mentioned weights per square inch of section acting gradually on a solid cylinder 10 inches long and 1.128 inches in diameter, cut 8 inches from the lower end, and perpendicular to the axis of a trial cylinder of hammered cast steel, made by the Bochum Mining and Cast-Steel Company, Bochum, Prussia.

Weight per square inch of section—pounds.	Compression per inch in length.	First difference.	Restoration per inch in length.	First difference.	Permanent set per inch in length.	First difference.	Weight per square inch of section—pounds.	Compression per inch in length.	First difference.	Restoration per inch in length.	First difference.	Permanent set per inch in length.	First difference.
1,000	.00000	.....	.....	.....	.00000	.....	11,000	.00023	.00003	.00009	.....	.00001	.00014
2,000	.00006	.....	.00006	.....	.00000	.....	12,000	.00025	.00002	.00009	.....	.00000	.00016
3,000	.00008	.00002	.00006	.....	.00002	.....	13,000	.00033	.00008	.00008	— .00001	.00025	.00009
4,000	.00009	.00001	.00006	.....	.00003	.00001	14,000	.00037	.00004	.00009	.....	.00001	.00025
5,000	.00011	.00002	.00006	.....	.00005	.00002	15,000	.00039	.00002	.00009	.....	.00000	.00030
6,000	.00013	.00002	.00007	.00001	.00006	.00001	16,000	.00044	.00005	.00008	— .00001	.00036	.00006
7,000	.00015	.00002	.00009	.00002	.00006	.00000	17,000	.00051	.00007	.00011	.....	.00003	.00040
8,000	.00015	.00000	.00007	— .00002	.00008	.00002	18,000	.00062	.00011	.00011	.....	.00000	.00051
9,000	.00017	.00002	.00007	.00000	.00010	.00002	19,000	.00060	.00018	Began to bend between 19,000 and 20,000 pounds.			
10,000	.00020	.00003	.00008	.00001	.00012	.00002							

VI.—Table showing the compression, restoration, and permanent set per inch in length, caused by the under-mentioned weights per square inch of section, acting gradually on a solid cylinder 10 inches long and 1.112 inches in diameter, cut from the exterior of a trial cylinder of hammered cast steel made by the Bochum Mining and Cast-Steel Company, Bochum, Prussia.

Weight per square inch of section—pounds.	Compression per inch in length.	First difference.	Restoration per inch in length.	First difference.	Permanent set per inch in length.	First difference.	Weight per square inch of section—pounds.	Compression per inch in length.	First difference.	Restoration per inch in length.	First difference.	Permanent set per inch in length.	First difference.
1,000	.00004		.00004				9,000	.00091	.00022	.00075		.00016	.00009
2,000	.00011	.00007	.00011	.00007			10,000	.00123	.00037	.00086		.00042	.00026
3,000	.00020	.00009	.00020	.00009			11,000	.00146	.00014	.00086		.00060	.00018
4,000	.00029	.00009	.00029	.00009			12,000	.00159	.00043	.00102		.00087	.00027
5,000	.00038	.00009	.00038	.00009			13,000	.00213	.00024	.00108		.00105	.00018
6,000	.00045	.00007	.00045	.00007			14,000	.00232	.00019	.00095		.00137	.00032
7,000	.00057	.00012	.00053	.00008	.00004	.00004	15,000	.00250	.00018	.00098		.00152	.00015
8,000	.00069	.00012	.00062	.00009	.00007	.00003							

VII.—Deflection, restoration, and permanent set produced by the under-mentioned weights applied to a rectangular bar cut from the exterior of a trial cylinder of hammered cast steel, made and furnished by the Bochum Mining and Cast-Steel Company, Bochum, Prussia.

The ends of the bar were held down by knife-edges 20 inches apart, and the center pulled upward by a knife-edge. Depth of bar, 2.080 inches; breadth, 2.080 inches.

Weight—pounds.	Deflection in inches.	First difference.	Restoration in inches.	First difference.	Permanent set in inches.	First difference.	Weight—pounds.	Deflection in inches.	First difference.	Restoration in inches.	First difference.	Permanent set in inches.	First difference.
1,000	.005		.005				12,000	.115	.050	.050	.002	.065	.048
2,000	.010	.005	.010	.005			13,000	.185	.070	.055	.005	.130	.065
3,000	.015	.005	.015	.005			14,000	.282	.097	.062	.007	.220	.090
4,000	.020	.005	.020	.005			15,000	.345	.103	.070	.008	.315	.095
5,000	.025	.005	.025	.005			16,000	.520	.135	.078	.008	.442	.127
6,000	.025	.0025	.025	.0025			17,000	.650	.130	.075	.003	.575	.133
7,000	.0275	.0025	.0275	.0025			18,000	.820	.170	.070	.005	.740	.165
8,000	.030	.0025	.030	.0025			19,000	.980	.160	.095	.015	.885	.145
9,000	.040	.010	.040	.010			20,000	1.140	.160				
10,000	.045	.005	.045	.005			21,000						
11,000	.065	.020	.048	.003	.017		22,000					1.226	

No sign of rupture.

VIII.—Deflection, restoration, and permanent set, &c., of a rectangular bar cut from near the axis of the same trial cylinder.

Depth of bar, 1.976 inches; breadth, 2.01 inches.

Weight—pounds.	Deflection in inches.	First difference.	Restoration in inches.	First difference.	Permanent set in inches.	First difference.	Weight—pounds.	Deflection in inches.	First difference.	Restoration in inches.	First difference.	Permanent set in inches.	First difference.
1,000							12,000	.290	.100	.060	.006	.230	.094
2,000	.010	.010	.010	.010			13,000	.430	.140	.060	.000	.370	.140
3,000	.015	.005	.015	.005			14,000	.575	.145	.065	.005	.510	.140
4,000	.020	.005	.020	.005			15,000	.747	.172	.077	.012	.670	.160
5,000	.027	.007	.027	.007			16,000	.935	.188	.090	.013	.845	.175
6,000	.030	.003	.030	.003			17,000	1.270	.335	.095	.005	1.175	.330
7,000	.035	.005	.035	.005			18,000	1.535	.265	.090	.005	1.445	.270
8,000	.040	.005	.033	.002	.007	.007	19,000	1.885	.350	.100	.010	1.785	.340
9,000	.065	.025	.045	.012	.020	.013	20,000	2.355	.470	.120	.020	2.235	.450
10,000	.110	.045	.043	.002	.067	.047	21,500	2.790	.435	.110	.010	2.680	.445
11,000	.190	.080	.054	.011	.136	.069							

No sign of rupture.

IX.—*Tenacity under a gradually increasing strain of a specimen of hammered cast steel cut from near the axis of a trial-cylinder 4 feet long and 2 feet diameter, made and furnished by the Bochum Mining and Cast-Steel Company, Bochum, Prussia.*

Original diameter, 1.128".

The strain was raised to 55,000 pounds per square inch and then taken off entirely, then raised again, and the specimen broke before reaching 55,000, with uniform fibrous fracture.

Diameter at point of rupture, .929".

Compressibility under a gradually increasing strain of a specimen cut from outside of the lower end of same trial cylinder.

Original diameter, .76"; length, 1.983"; density, 7.8481.

The strain was raised to 150,000 pounds per square inch, and then taken off entirely. There was no sign of rupture, but only a lead-like yielding of the specimen.

Length of the specimen after compression, 1.210".

Compressibility of a specimen cut from the outside of upper end of the same trial cylinder.

Original diameter, .76"; length, 1.983"; density, 7.8481.

The strain was raised to 176,000 pounds per square inch, and then taken off entirely. No sign of rupture.

Length of specimen after compression, 1.072".

Bursting test or tangential strain of a hollow cylinder 6 inches long and 3 inches diameter with a bore 1 inch in diameter, cut from the outside of the same trial cylinder.

The bore was filled with water, and, by means of a piston, the strain was raised to 40,000 pounds per square inch, and then taken off. Diameter of bore, 1.014"; strain raised again to 48,000 pounds per square inch, then taken off; then raised again, and the packing gave way before 48,000 pounds per square inch was reached. Diameter of bore, 1.02".

The bore was then filled with a mixture of bees-wax and tallow, and the strain was raised to 53,000 pounds per square inch, when the packing gave way.

Diameter of bore, 1.047".

The bore was then cast full of lead, and the strain raised to 101,000 pounds per square inch, when the piston bent and jammed in the bore.

No sign of rupture to the cylinder. Exterior diameter slightly enlarged at center.

W. P. BUTLER,
Second Lieutenant Ordnance.

No. 53.]

OFFICE OF HERMANN BOKER & CO.,
New York, July 22, 1872

COLONEL: We herewith hand you copy of letter received of Bochum Verein, dated July 9, in answer to our telegram sent by your request, as also tracing of 12-inch muzzle-loader, which is one-twelfth part of original size.

Yours, respectfully,

HERMANN BOKER & CO.,
Agents for Bochum Verein, Bochum, Westphalia.

Colonel S. CRISPIN,
Major of Ordnance, Greene and Houston Streets, New York.

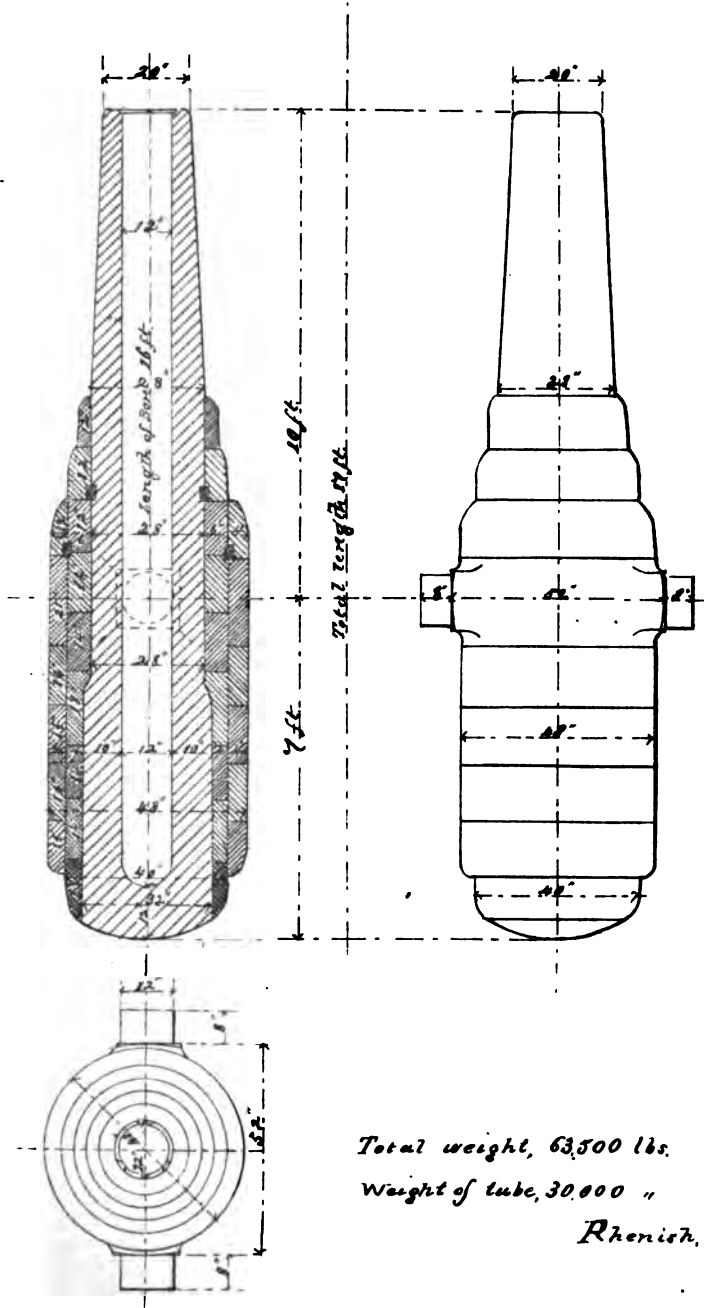
[Indorsement.]

UNITED STATES ORDNANCE AGENCY,
New York, July 23, 1872.

Respectfully referred, together with its inclosures, to the board on heavy ordnance convened by General Order No. 57, dated June 28, 1872.

S. CRISPIN,
Brevet Colonel, U. S. A., Major of Ordnance.

12 INCH MUZZLE-LOADING CANNON.



Total weight, 63,500 lbs.

Weight of tube, 30,000 "

Rhenish.

Bochum 5 July 1872.

[Inclosure.]

BOCHUM, July 9, 1872.

Messrs. HERMANN BOKER & Co., New York:

We received your telegram: "How soon, and at what price, can you deliver 12-inch-caliber guns? Ordnance board in session this month to receive specifications." To which we reply that we regret to report our inability to make 12-inch breech-loaders for the present. As far as now we are only prepared to build 9-inch breech-loading, Prussian system. Our preparation for making heavier guns could only be undertaken if we were supported by an order for a number of such heavy guns as caliber 12, and on condition that we were to receive a reasonable advance to defray the preliminary expenses.

To involve ourselves in such a costly enterprise without direct orders in hand, we hesitate for the present.

Should your Government, however, also desire 12-inch-caliber muzzle-loaders, as we infer from your telegram, then we are in a position to offer you these guns according to the with following drawings.

The barrel is solid cast steel, rifled, rib system, with fifteen steel rings, and two double rings. Further particulars we will report later. The gun weighs, when completely finished, 63,000 pounds; the cast-steel tubing, 30,000 pounds. We are able to deliver the first gun within twelve months after receipt of order, the second gun about two months later, the third gun one and one-half (about) months later than the second.

BOCHUMER VEREIN FÜR BERGLEAU UND GUSSTAHLFABRICATION.

HERMANN BOKER & Co.,
Sole Agents for United States.

E. L. BROWN.

H. O. No. 3, (f.)]

No. 27 WALL STREET, New York, February 8, 1872.

SIR: Some time since I had the pleasure of calling your attention to a new method of manufacturing heavy ordnance. You were good enough to reply, requesting that I should give you the details of the process, but for various causes I have been unable to do so until now.

This plan has for its sole object the strengthening of heavy guns. It consists simply in making a core or skeleton of wrought-iron wire-rope or bars, of the same general shape as the gun to be cast, placing this in the mold, and casting the gun upon or around it.

I am well aware that the general method of strengthening cannon by an inside wrought-iron frame-work has been before the public for some time, and has had very injudicious friends; but the practical cause of the failure has been that it has been found impossible to secure a perfect casting free from blow-holes or other defects. The peculiar and only characteristic feature of the method I now lay before you, is that by it a perfect casting can be invariably secured. This is attained by casting the wrought-iron skeleton with nickel or some other substance that will melt only at a higher degree of temperature than the cast iron that is poured about it.

For a full description of this process, I beg to refer you to the inclosed copy of specification of Mr. Brown's patent.

I deem this an opportune time to bring this matter to your attention, and will be glad at any time to lay before you positive and incontestable proof that what is claimed by the patent can be done. The patent is in use for other purposes than ordnance, at one of our largest iron-works, and perfect castings are, by it, always secured.

Yours, very respectfully,

TREADWELL CLEVELAND.

The CHIEF OF ORDNANCE, Washington.

[Inclosure.]

Specification of patent granted to Edward L. Brown, No. 78,786, granted June 9, 1868.

Be it known that I, Edward L. Brown, of the city of Philadelphia, State of Pennsylvania, United States of America, have discovered a new and useful metallurgical process for use in the mechanic arts.

In order to enable the public to understand the nature of my invention, and those skilled in the arts to use the same, I describe it as follows:

Wrought metal is valuable in castings on account of its tensile strength, the tensile

strength of wrought metal being nearly double that of cast metal. In efforts that have hitherto been made to introduce wrought metal into castings for the purpose of imparting to them additional strength to resist various strains or concussions, the wrought metal has been first coated with tin, or some other metal easily fusible, to act, first, as a solder or means of union between the wrought and metal, and second to absorb a part of the heat of the cast metal and thus prevent the crystallization or granulation of the wrought metal. The use in this connection of a metal or alloys of metal easily fusible, is, I believe, valueless, indeed worse than that, positively injurious, and for the following reasons: it is unnecessary as a solder, for, by my process, the cast metal shrinks closely around the wrought metal and forms a perfectly tight joint, and the compact combination of the metals is also further secured as hereinafter mentioned. In order to have the fusible metal act as a solder a considerable thickness of it must be used, and thus a layer of comparatively weaker metal, either the solder alone, or the solder alloyed with the cast metal, must necessarily intervene between the wrought metal and the body of the cast metal. The fusible metal or alloy acting as a solder, does absorb some of the heat of the molten cast metal, but in so doing it melts, and allows the cast metal, at a heat only slightly diminished, to come in contact with the wrought metal. This melting of the fusible metal produces various injurious results. The wrought metal, under the influence of the heat of the cast metal in contact with it, is crystallized, either entirely or partially, and its fiber commensurately destroyed, and to a degree sufficient to materially reduce its tensile strength. The tin or other fusible metal or alloy in melting is chemically decomposed, and a gas or gases generated, which, being very volatile, and elastic, must expand and force their way into or through the molten metal. These gases generally showing their effects on the cope, or upward side of the castings, force their way either entirely through the castings, thus forming blow-holes visible from the outside, or partially through the castings, not discernible till the casting be broken. When broken these castings present a honey-combed or spongy appearance, full of cells and holes of irregular shape, caused by the gases generated as above mentioned; and for this reason it is utterly impossible, as I believe, to make as solid compound casting with the use of any fusible metal or alloys of metal as a coating for the wrought metal. If wrought metal be used without any coating, either heated or cold, polished or unpolished, the molten metal by its heat decomposes the oxide of iron which it is well known is always present in all iron in a greater or less degree, and releases the oxygen gas. This gas forces itself into or through the casting in a similar manner as the gas generated from the fusible metal or alloy as above mentioned, and causes the casting to present a similar appearance of honey-combing or sponge. All these gases, whether evolved from the oxide of the wrought metal, or from the decomposition of the fusible metal, act as an elastic cushion and prevent the close shrinkage of the cast metal around the wrought metal. The true solution of the problem, which I claim to have discovered from my extensive researches and experiments, is this: to present to the molten metal, instead of an easily fusible metallic surface, and one thus readily resolved by heat, a metal, alloy of metal, or metallic or mineral substance difficult or impossible to melt at the degree of the heat of the molten metal poured about it. I thus secure important and essential results, and the following is a description of my process: That all, iron though perfectly cleansed, is very easily, indeed almost instantaneously oxidized by exposure to the atmosphere, and that the presence of a high heat on an oxidized surface releases the oxygen gas, and that oxygen gas is very volatile and elastic, are well-known facts. It is also true that the action of molten metal at a great heat on any easily-fusible metal, or on any metal fusible at a less degree of heat than the molten metal, evolves from that fusible metal, when heated to the point of fusion, a volatile and elastic gas. It is therefore essential, in order to produce a solid casting combined of wrought and cast metal, to prevent the formation of the oxygen or other gases during the process of casting. To accomplish this result, I first thoroughly cleanse the wrought metal by use of acids or otherwise, and immediately thereafter thoroughly and perfectly coat it with a non-oxidizable metal or substance very difficult to fuse. For this coating it is necessary to use a metal or substance that will melt only at a higher heat than the cast metal that is to be poured about it. I prefer to use nickel for this purpose, as this melts only at an exceedingly high heat, much higher than that of iron, and indeed is almost impossible to fuse.

Other metals, such as platinum, can be employed; and I believe that such non-oxidizable and non-conducting substances as plumbago can be successfully used for this coating. The wrought metal should be coated immediately after being cleaned to prevent oxidation from taking place, and is covered with its coating by means of galvanic-battery or other electric action, or by means of heat or other chemical process. In order to obtain a perfect coating of the non-fusible metal, the wrought metal must be very thoroughly cleansed, and it may be first coated with copper or other metal for which iron has a great affinity, to serve as a basis for the coating of the non-fusible metal. The molten cast metal cannot, when it comes in contact in the mold with the wrought metal thus prepared, melt this coating, and cannot strike the wrought metal

itself. No gas can be evolved either from the coating or from the wrought metal. The cast metal shrinks closely and tightly about the wrought metal, and not coming in contact with it, but with a coating that it cannot melt, that is not oxidizable, and does not readily conduct heat, it cannot impair the fiber of the wrought metal. No gas being evolved, no blow-holes, honey-combing, or cells are formed, and a perfect and solid casting is produced without difficulty. My experiments justify the conclusion that neither gold, silver, copper, nor tin can be used for this coating in iron manufacture, as they all melt, and consequently oxidize, and generate gas, at a much lower heat than the cast metal. Only such metals, alloys, or substances can be used as will not melt at the degree of heat required for casting metal. By the process above described the cast metal shrinks closely about the wrought metal and holds it firmly without the intervention of any solder. But to secure this result beyond any possible doubt and prevent displacement under the heaviest concussions, before coating the wrought metal I rag or barb it with a sharp chisel, or otherwise roughen or corrugate it. About each of these points, projections, or irregularities, however produced, the cast metal flows, and they thus act as internal rivets. By this means the wrought metal is more firmly imbedded than can be done by any solder.

I believe that the above-described process of coating the wrought metal with a non-fusible metal or substance is the exact opposite of all methods heretofore employed in the combination of wrought and cast metal in castings, and is the only one by which solid castings composed of wrought and cast metal can be made.

Therefore what I claim as new and useful, and what I desire to secure by letters-patent of the United States of America is, preparing wrought metal for combining it with cast metal for castings of all descriptions, where great strength of any kind is required, by first thoroughly coating it, by galvanic action or other process, with nickel or any other metal or metals, alloys of metals, or metallic or mineral substances or their alloys, not easily oxidizable and very difficult to fuse, and which only melt or whose point of fusion is at a higher degree of heat than the molten cast metal to be poured about it, the whole substantially as, above described. The production of castings strengthened by the introduction of wrought metal coated with a metal, alloy of metals, or substance less fusible than the cast metal, substantially as above set forth.

No. 6.]

No. 56 WALL STREET, New York, July 10, 1872.

GENTLEMEN: I herewith submit to you, on behalf of Edward L. Brown and myself, the following method of strengthening heavy cast-metal ordnance. This plan consists in forming a frame-work or net-work of interlaced rods, bars, or chains, of the same general shape as the piece to be cast, and placing this frame in the center of the mold before casting. The cast metal being poured about it, penetrates through the interstices of the net-work, and a gun is made of outwardly the same appearance as those in use, but having this wrought-metal frame-work imbedded in it. If preferred the strengthening core can consist of a barrel of steel or iron. I am aware that this method of strengthening ordnance has been heretofore partially tried, and unsuccessfully; but the only objection I know of, urged against this plan, was the fact that the gun, when broken up, was found not to be a solid casting. The new and patented feature of the plan now submitted consists in securing invariably a perfect casting. This result is attained by coating the wrought-metal core with nickel or a metal which the cast metal will not melt. The details of the process are set forth in the patent granted to Mr. Brown, a copy of which is herewith submitted. This process has been for some time in daily use by the Taylor Iron-Works at High Bridge, New Jersey, for the manufacture of car-wheels, and has given complete satisfaction to the experienced iron-founders of that establishment, a perfect casting, free from blow-holes or other defects arising from the use of the wrought metal, being always secured.

No particular form of frame-work or core is suggested; that will be used which will be thought best to resist the different strains. It is confidently submitted that the principle of manufacture for the purpose of gaining strength is a correct one, and that the process patented will secure perfection of casting.

Very respectfully,

TREADWELL CLEVELAND.

Colonel R. H. K. WHITELEY, Colonel GEORGE W. GETTY, and the members of the Board appointed by the War Department for the purpose of examining models of heavy ordnance under late act of Congress.

[NOTE.—The inclosure of the above was the same as that of the preceding letter.]

No. 57.]

NEW YORK, July 23, 1872.

SIR: I beg leave to submit for the consideration of your board the following views in relation to the manufacture of heavy cast-iron ordnance.

The success of the bronze gun made in accordance with the suggestions of Dr. Woodbridge, and tested at the Springfield arsenal, is, I believe, acknowledged; and I understand that the attempt to apply the same principle to cast-iron guns failed for the following reasons:

1. Imperfection of the casting, from honey-combing or blowing.

2. Loss of tensile strength in the steel wire or rods, from granulation or crystallization of the fiber.

Should such be the case I propose to remedy and remove entirely the above-named objections by preparing the rods in the manner described in the patent-paper herewith, and to make a solid casting, having a series of rods or wires therein, the fibers of which shall be perfect and preserved in all their integrity. As proof of my ability to do this I send a small sample, cut in such a manner as to show the solidity of the cast iron, and the closeness of the shrinkage about the wire or rods. This process has been in successful use for some time past by the well-known Taylor Iron-Works at High Bridge, New Jersey, in the manufacture of car-wheels, to whose general manager, Mr. William I. Taylor, I would refer.

The principle involved is simply that by coating the wire with a substance that will not oxidize, no gas can be generated to honey-comb the molten cast iron, which, on cooling, must therefore be perfectly solid.

The coating being non-fusible at the temperature of the molten cast metal poured about it, forms a fire-proof covering to the wire, through which no carbon can pass from the molten metal to granulate the fibers.

Should your board deem this matter of sufficient importance to investigate more fully, I would be pleased to make an oral and more definite explanation, at such a time as it may suit your convenience to appoint.

Requesting the return of the original patent-paper when you have finished with it,

I have the honor to remain, very truly, your obedient servant,

EDWD. L. BROWN,

No. 93 Liberty Street, New York City.

The PRESIDENT OF THE BOARD ON HEAVY ORDNANCE.

T. W. CLARK.

No. 48.]

WAUSAU, Wisconsin, July 17, 1872.

DEAR SIR: Having received from the Ordnance Office, War Department, at Washington, a copy of General Order No. 57, and a request to present to you my plans and specifications for breech-loading cannon, I now comply with said request. Not being sufficiently proficient in the art of draughting to get up a suitable plan, I will confine myself to description. I propose to use a main barrel similar to the Parrott gun, the greatest weight of metal to be put where the greatest pressure comes upon it. I propose to use fixed ammunition, of the water-proof copper-percussion-cartridge style. Instead of using a revolving cylinder, with chambers drilled through it, I propose to use two revolving cylinders with one-half of a chamber grooved in opposite sides of each cylinder. The breech of the main barrel is to be securely fastened in a heavy steel cross-piece which shall be wide or long enough laterally to receive the gudgeons on the front end of the cylinders, and also the heavy bolts that will connect it with a similar cross-piece or backing at the rear end of the cylinders. The gudgeons or arbors on the rear end of the cylinders to be long enough to press entirely through the backing, and to receive, each of them, a bevel pinion-wheel which shall meet with a double pinion-wheel, which shall be just about the center of the cylinders, and shall revolve them downward in the center. The cylinders shall be held stationary, while in the act of firing, by means of notches in the cylinders, and a spring-catch underneath; the notches to be so placed that the half chambers shall exactly match with each other, and also with the bore of the main barrel. The cartridge is to be exploded by means of a steel spindle or "needle" passing through the back cross-piece, and which shall be withdrawn a little by means of a hair-spring, and which shall be made to strike the cartridge by a blow from the mainspring, which shall stand perpendicular just behind the back cross-piece, and shall be worked by means of a cam or catch on the edge of the double pinion-wheel, which shall catch the top end of the mainspring and bend it back and then let it fly at the instant the cartridge is in the proper position. The double pinion-wheel spoken of to be on a horizontal transverse shaft, with a crank on the right-hand side of the breech, the gun to be worked by one man turning the crank with his right hand and tending the spring-catch lever with the left hand. The ammuni-

tion to be in a hopper-shaped box above the cylinders; the cartridges to roll down between the cylinders as fast as used, and the exploded cartridge-shells to drop out at the bottom. By these means one man will fire two shots at every turn of the crank, and will easily fire sixty rounds per minute.

In my opinion the shot or shell for long-range firing should be of conical form, the iron projectile to be a trifle smaller than the bore of the gun, and be coated or incased with lead. The rifling of the main barrel should be on the gain-twist or increase-twist principle, and the bore of the gun what is called press bore, i. e., the caliber at the muzzle should be one-sixteenth to one-fourth of an inch less than at the breech, so as to force the lead into the creases of the gun and compel the shot to acquire the whirling motion necessary to insure accuracy.

I wish that the Board of Ordnance would order the construction of a gun on this plan at the Springfield Armory, or elsewhere. I believe it to be far in advance of anything now in use; and in case of an appeal from the Geneva arbitration to the God of battles, the supreme court of nations, it would be of great importance to our country to have better arms than our opponents.

For heavy artillery I would have the powder in the copper cartridge detached from the ball, and dispense with the hopper, and get the ball to the cylinders by rolling it on a level or down a gentle incline, and place the powder-cartridge behind it by hand. This would be easy, as the charge of powder for the largest gun does not exceed 35 or 40 pounds. For a sample gun I would recommend 3-inch caliber; an old Parrott gun could be used for the main barrel. If you desire it I will cheerfully give you my opinion in regard to the size and proportions of the various parts.

Hoping to hear from you on the subject, I remain, very truly, your obedient servant,

T. W. CLARK,
Wausau, Wisconsin.

Colonel R. H. K. WHITELEY.

[Inclosure.]

Some observations regarding ordnance in general, and the advantages of Clark's breech-loader in particular.

I hold that the points of excellence in ordnance consist:

1. In accuracy.
 2. In random or long range.
 3. In ease and rapidity of loading and firing.
 4. In cheapness.
 5. In simplicity of construction, fewness of parts, and small liability to get out of order.
 6. Ease of rendering gun useless in case the necessity should arise of abandoning it to the enemy.
 7. Ease of altering elevation.
1. In regard to the first point I hold that the accuracy of a gun depends upon the length of the barrel, and the trueness and polish of the bore, and upon the proper adjustment of the sights; and as I would use a long main barrel of the best possible construction, I claim an equality with the best on the point of accuracy.
2. I hold that the random or range of a projectile depends on the quantity and quality of the powder or other explosive compound used, and upon the elevation. On this point I claim equality with the best.
3. I firmly believe that I can work field-artillery, of any caliber not exceeding 4½ inches, at the rate of forty to sixty shots per minute. In regard to heavy siege and naval guns I believe guns, of my plan, of 11 or 12 inch caliber, will easily deliver five shots per minute, and guns of 15-inch to 20-inch caliber, two shots per minute. On this point I claim immense superiority over any other gun ever invented of equal accuracy and range.
4. Cheapness. I do not think my guns will cost more than 25 to 50 per cent. more than ordinary muzzle-loaders of the same caliber.
5. There will be the fewest parts used that is possible to accomplish the objects sought, and the liability to get out of repair will be reduced to the minimum.
6. The gun can be rendered temporarily useless, either by removing or breaking the crank, which can be done in a few seconds.
7. The breech will rest on a jackscrew, the same as a common muzzle-loader, and can be elevated or depressed the same.

T. W. CLARK,
Wausau, Wisconsin, formerly of the Army of the Tennessee.

No. 48.]

WAUSAU, WISCONSIN, July 17, 1872.

DEAR SIR: Having received from the Ordnance Office of the War Department a copy of General Order No. 57, and a request to present to your board my plans and specifications for a breech-loading cannon, I now comply with said request. Not being sufficiently proficient in the art of draughting to get up a suitable plan, I will confine myself to a description. I propose to use fixed ammunition of the water-proof copper percussion-cartridge style. I propose to use a main barrel similar to the Parrott gun; the greatest weight of metal to be put where the greatest pressure comes upon it. Instead of using a revolving cylinder with chambers drilled through it, I propose to use two revolving cylinders with one-half of a chamber grooved in opposite sides of each cylinder. The breech of the main barrel is to be securely fastened in a heavy steel cross-piece, which shall be wide or long enough transversely to receive the gudgeons on the front end of both cylinders, and also the heavy bolts that will connect it with a similar cross-piece or backing at the rear end of the cylinders. The gudgeons or arbors on the rear end of the cylinders to be long enough to pass entirely through the backing and to receive, each of them, a bevel pinion-wheel which shall meet with a double pinion-wheel on a transverse shaft, which shall be just above and to the rear of the bevel-pinions on the cylinder-gudgeons, and shall revolve the cylinders downward toward each other. The cylinders shall be stationary, while in the act of firing, by means of notches on the cylinders and a spring-catch underneath; the notches to be so placed that the half chambers shall exactly match with each other and also with the bore of the main barrel. The cartridge is to be exploded by means of a steel spindle, or "needle," passing through the back cross-piece, the "needle" to be withdrawn a little by a hair-spring, and to be made to strike the cartridge by means of a blow from the mainspring, which shall stand just perpendicular behind the back cross-piece, and shall be worked by means of a cam or catch on the edge of the double pinion-wheel, which shall catch the top end of the mainspring and bend it back, and then let it fly at the instant the cartridge is at the proper position. The double pinion-wheel spoken of to be on a horizontal transverse shaft, with a crank on the right-hand side of the breech. The gun to be worked by one man turning the crank with his right hand and tending the spring-catch lever with his left hand. The ammunition to be in a hopper-shaped box above the cylinders, the cartridges to roll down between the cylinders as fast as used, and the exploded cartridge-shells to drop out at the bottom. By these means one man will fire two shots at every turn of the crank, and will easily fire ten rounds per minute. In my opinion the shot for long-range firing should be conical in form, and a little smaller than the bore of the gun, the deficiency being made up by a coating of lead. The main barrel to be rifled on the increase-twist principle, and to be one-sixteenth to one-fourth inch smaller at the muzzle than at the breech, so as to force the lead into the creases of the gun, and give the shot the whirling motion necessary to insure accuracy.

For heavy siege or naval guns I would have the powder in the copper cartridge detached from the shot and dispense with the hopper, and get the shot to the cylinders by rolling it on a level, or down a gentle incline, and place the powder-cartridge behind it by hand.

For guns of 12 to 20 inch caliber I only claim from two to five shots per minute, which I believe is a great advance on present practice.

I would like to be informed of any criticism or objection of any member of the board, that I may have opportunity to explain any matter satisfactorily. Hoping to hear from you, I remain,

Very respectfully, your obedient servant,

T. W. CLARK,
Wausau, Wisconsin.

Lieutenant C. E. DUTTON.

MAJOR S. CRISPIN.

H. O. No. 3 (b).]

OFFICE OF THE UNITED STATES ORDNANCE AGENCY,
New York City, June 12, 1872.

GENERAL: In recent interviews with some of the members of the permanent board of engineers of the United States Army my attention has been forcibly called to the subject of the utilization of our existing granite casemated sea-coast defenses, by the replacement of their present smooth-bore armament and the introduction of rifled guns of the highest power which these works, from their capacity, will admit of being applied, and which armament will also be of adequate power for many other positions not needing our heavier calibers of 10 and 12 inch rifles.

The enormous cost of these works, and the necessity of their utilization by the introduction of an armament not too bulky for their construction—effective against iron-clads, as at present constructed—to replace their present low power, 8 and 10 inch

smooth-bores and others, and motives of economy, should lead, in my judgment, to experiments with a view of determining if conversion (already successfully inaugurated in the English service) of our cast-iron smooth-bores to rifles of greatly increased power cannot be satisfactorily made in our service, thus utilizing both guns and casemates.

The recommendations of the armament board of 1867, restricting our calibers to 10 and 12 inches for rifles, provide only for constructions of a capacity for their introduction; but as rifled ordnance, at least as low in caliber as 8 inches, can be effectually used against iron-clads, this question of the utilization of existing works, inadequate for our standard calibers, receives additional importance.

Considering that General Rodman, in his plans for heavy ordnance, contemplated an excess of strength for practical use, and knowing that England has already converted over 500 71-cwt. smooth-bores, and has 100 more now under way at Elswick, (*prima facie* evidence of success,) it would seem that we would be warranted in undertaking the experiment of the conversion of a 10-inch smooth-bore Rodman gun into a rifle, of a caliber of either, say, 8 or 8½ inches; the exact caliber to be determined by a thorough examination and consideration of data, and the formation of a mature judgment as to what should be the maximum bore, consistent with a safe and durable converted gun. The general principles of conversion proposed—the lining of the bore with a tube—it will be remembered, was proposed for 10 and 12 inch experimental rifles by the ordnance board of 1868.

Accurate data at present are not at hand regarding the English plan of alteration, understood to be the design of Palliser, but its general features consist in boring out the cast-iron guns, (8-inch caliber,) and the insertion from the front of a wrought-iron coil tube, 6.4 inches interior diameter, rifled bore. The tube, closed by a screw-plug at the rear, and fitting not too closely, is secured at the muzzle by a hollow plug, screwed into the cast iron, and fitting over the tube, turned down at the muzzle about half its thickness to receive it. The first charge permanently sets the tube in close contact with the cast-iron walls. Parson's plan (American) in general consists in the introduction of a re-enforced steel tube, bored from a solid bar, introduced through the breech, differing thus in mode of introduction and character of metal of the tube from the plan adopted in the British service.

Reports of a 64-pounder, (English,) altered to so high a caliber as 8 inches, (on the Parson plan,) claim extraordinary endurance with full charges, and that the yielding of the gun was gradual, and not sudden, as in the case of pure cast iron. It is of course a desideratum that the highest caliber consistent with safety should be obtained in our alteration, and it may be that the superior quality of our cast-iron 10-inch hollow-cast gun may enable us to reach, say, 8½ inches. In this case it is probable a coil-tube of wrought iron, 2 inches thick, would be required. This will require the cast-iron gun to be bored out 2.50 inches, or 1.25 inches taken from the walls.

The tube would weigh 2,200 pounds, and have an exterior diameter of 12.5 inches. The present weight of gun of 15,059 pounds would be increased to about 15,800 pounds, about the weight of our present 8-inch rifle. A maximum thickness of walls (only 12 inches in Parrott's 8-inch) would be ¾ inches greater than the present 8-inch rifle, and the thickness of the muzzle would be 3.85 inches, a little less than the present cast-iron 8-inch, but superior in strength, it is believed, at this point, to either the 8-inch rifle or even Parrott's 10-inch, and in other respects decidedly stronger than the Parrott 8-inch. Its length of bore would be 120 inches, as in the 8-inch rifle, and be only 5 inches shorter than the English 9-inch (12-ton) Fraser gun. It is believed that a charge of 20 to 30 pounds of powder, with a 225-pound projectile, could be used with this gun. The 9-inch English uses 43 pounds of powder, and a 250-pound projectile.

The center of gravity would be thrown to the front of the axis of the trunnions by the proposed change, but this, it is believed, not sufficiently as to lead to any difficulties which cannot be met by a practical and easy solution. The cost of the alteration is an essential item. By consulting English official records I find the cost of alteration of a "65-cwt. 8-inch gun to a 71-cwt. 64-pounder," is less than £100, or, say, \$600 United States currency. If these figures are correct, it will set at rest the question of comparative expense of new 8-inch cast-iron rifles and the converted guns, the former costing nearly \$2,000 for their construction. Evidently economy as well as strength points to the converted gun as the superior for our casemates requiring rifle-guns of this size. If 8-inch is proposed for caliber, I would suggest a boring out of 2.50 inches, and the using of a tube 2.25 inches in thickness. The wrought-iron coil tube would weigh 2,330 pounds, and the gun 15,990 pounds, with a maximum thickness of walls of 17 inches, and 4.10 inches thickness at the muzzle; a strong gun, and one capable, it is presumed, of firing a heavier charge and weight of projectile than our present 8-inch rifle.

It is evident that a 6.4-inch rifle, if the 10-inch experiments should prove a success, can be made, if this caliber is not deemed too low for effective service, from our present 8-inch smooth-bore.

This experiment, preliminary to the one proposed by the board of 1868 to line a 10

and 12 inch rifle, would, at a moderate cost, throw considerable light upon this subject, and is another reason for its being undertaken.

If the proposed experiment is authorized, its cost, firing 500 rounds, may be approximately estimated as follows, to wit:

Cost of alteration of gun	\$1, 200
150 barrels of powder.....	3, 000
Projectiles, ($\frac{1}{2}$ recovered)	3, 750
Labor, &c	1, 250
Total	9, 200

The power to be obtained from this gun should be at least that resulting from 1,200 feet initial velocity and 225 pounds weight of metal, or say energy at the muzzle about 4,900,000 foot-pounds. The 9-inch English gun, with an initial velocity of 1,336 feet and a 250-pound projectile, has an energy at the muzzle of, say, 6,900,000 foot-pounds. It is deemed best, if it is determined to institute experiments in this direction, that data be obtained by this office as to the details of the English mode of conversion, and also as to the parties who can manufacture the tube, (it is presumed that this will have to be imported,) its cost, and other information which might be of use in enabling the Department to decide upon the merits of the English mode, and other matters of information in this connection. The question of proper caliber and mode of alteration—Palliser's, Parson's, or any others submitted—can, if desired, be determined by a board. It is believed that if the conversion is a success, wrought-iron coil tubes can be secured in this country after a short time. Hoping that these general views may meet with favorable consideration and action, and that moneys are now in the hands of the Department available for the purposed experiment,

I am, sir, very respectfully, your obedient servant,

S. CRISPIN,

Brevet Colonel, U. S. A., Major of Ordnance.

General A. B. DYER,

Chief of Ordnance, U. S. A., Washington, D. C.

E. WILER DUNLAP.

No. 70.]

TRENTON, NEW JERSEY, July 22, 1872.

To special board of ordnance for testing heavy guns: Colonel R. H. K. Whiteley, Ordnance Department; Colonel George W. Getty, Third Artillery; Lieutenant-Colonel H. G. Wright, Corps of Engineers; Lieutenant-Colonel T. T. S. Laidley, Ordnance Department; Major T. Seymour, Fifth Artillery; Major Silas Crispin, Ordnance Department; First Lieutenant C. E. Dutton, Ordnance Department, and recorder of board:

GENTLEMEN: I beg leave, in accordance with your request, to submit for your consideration the following paper. I shall enter into no dissertation on the merit or demerit of any well-known gun, but shall confine myself to a plain, straightforward explanation of the theories upon which I base the construction of my rifle. I shall be brief as possible; will use no scientific terms nor technical words to create erroneous impressions, but language so plain as to admit of neither doubt nor misconstruction.

The gun which I offer for the consideration of the board is a steel breech-loading rifle, of varying calibers, but the principles I advance are more applicable to a gun of 15 inches. My claims are superior accuracy, greater penetration, and longer range than any rifle yet made. The bore of the gun is of an equal caliber from muzzle to chamber.

Principle.—Many breech-loading guns are made upon what I term the force-principle, and thus cause the projectile to generate a terrible amount of friction; and not only this, but it often happens that the crude material of the projectile, while passing through this ordeal, comes in contact with the gun. The result is diminished power, deep scratches, and ultimate wearing of the cutting-edges of the grooves perfectly round, and in some cases long thin slivers have been torn from the edges of the grooves. The manner of remedying these defects is very simple. It is to be found in an equal caliber, assisted by a peculiar groove. My gun is rifled with four grooves, which make but one revolution in the entire chase, 8 feet. These grooves are at the muzzle $\frac{1}{4}$ inch in depth, but with a gradual increase to the shoulder, where they reach a depth of 1 inch, and thus correspond in depth to the retreating shoulder.

The theory upon which I have based the construction of these grooves is to give the projectile a medium rotary motion, and accomplish it with as little friction as possible.

All the above theories culminate in the retreating shoulder. The angle of this

shoulder is not so acute but that it will readily allow the outer surface of the sabot to slip easily into the grooves, and the superfluous metal becomes compressed at once, and undergoes no change during its passage through the bore. Hence no continued or progressive friction is exerted upon it, as in the force-principle. The metal that enters the grooves must, of a necessity, fill them accurately, and the little friction generated by this metal in its depression from 1 inch to $\frac{1}{4}$ inch, is passed upon a surface so small as to need no comment. The adherents of the old principles of the so-called scientific gunnery may say that the extraordinary pressure brought to bear against the sabot by the retreating shoulder, will be so great as to tear or break the sabot and thus leave a ragged surface for atmospheric pressure to work upon, the result of which would be diminished power, and inaccuracy of flight.

This is an erroneous impression, inasmuch as the shoulders of the sabot are deeply corrugated or scored, and as the sabot is cast upon these shoulders, it becomes a part and parcel of the projectile, and cannot be torn off. Again, as the retreating shoulder is an easy angle, the compression or elongation of the sabot is not accomplished by a blow, but takes place in a manner which cannot be antagonistical to any solid principle.

The advantage of the retreating shoulder is so palpably plain, and so consistent with every correct idea of expansive force, as to need but a few words; and yet, in justice to it, I will call the attention of the board to the advantages it possesses over all other forms as applied to heavy guns. Those ignorant of the properties of explosives naturally imagine that a service-charge of powder will burn with electrical quickness; but, gentlemen, you know that this is not true, for a certain amount of time must elapse between its ignition and complete change into the gaseous state. Admitting this to be true, a means of rapid ignition must be had, and this can be accomplished by firing from the bottom.

All the members of the board are thoroughly conversant with the properties of powder, so I will allow them to form their own conclusions regarding this important hypothesis, confident that my theory will prove correct. And here it is that the retreating shoulder proves its superiority over all other forms, because the change at that particular time of ignition possesses the greatest expansive force, and thus the shoulder enables it to perform the greatest amount of work at that particular time, and all this work takes place in the space of a few inches, thus doing away with the absurd idea of weakening that power, when every means should be adopted to augment it.

I am positive that the expansive force of the charge can be husbanded in no more scientific way than by the aid of the shoulder. After a thorough and complete analysis of the force-principle, I find that at least one-eighth of the entire expansive force possessed by the charge is rendered as nil by the extraordinary amount of friction generated by the projectile in its forced passage through the bore. In concluding this part of my paper, I will add that I have arrived at these conclusions by logical deductions, and no surmise exists in any shape, but a string of facts that cannot be broken.

The breech is of a peculiar construction, and so formed that when the breech-block is in place, it becomes most truly a part of the gun, fitting so accurately that the explosion cannot move or jar it the one-hundredth part of an inch.

On loading the piece the concave top of the block accommodates itself to the lower rim of the chamber, thus acting as a rest and a slide for the projectile, enabling the piece to be loaded with as much ease as any heavy gun possibly can be. The charge is inclosed in heavy flannel, the cartridge encased in stout canvas, preserving its cylindrical form by aid of a block of wood turned to fit the chamber, and attached to the base of the cartridge. As this block is made of deal, it adds no perceptible weight to the cartridge, and by being made of different thicknesses, the charge is varied from experimental to service.

This block projects beyond the rim of the chamber, (by a slant,) and as the breech-block is raised to its place the wooden block is forced in upon the charge, and it in turn is driven firmly against the base of the projectile, thus accomplishing a compression necessary to augment the expansive force of the charge. This compression also forces the shoulder of the sabot to rest firmly against the retreating shoulder, and as these shoulders are analogous to each other, no particle of air can remain between them, hence no windage can exist. The principles I have endeavored to explain should be applied to a large gun and not to one of small caliber, contending, as I do, that a gun of my dimensions will increase power in a manner never thought of before, and the ratio of increase of power can be easily determined by any member of the board who will carefully analyze the principles involved.

A gun of my dimensions, to prove serviceable, must possess the same ease of handling as a smaller gun. This I have accomplished, not only by a proper distribution of metal throughout the piece, thus enabling it to be elevated or depressed with as little effort as required by a field-piece, but, by the aid of anti-friction rollers connected to the carriage, a lateral movement is accomplished with ease and rapidity.

The shape of a gun contributes nothing to its efficiency, and yet there are certain lines symmetrical in themselves and correct in principle, which form a pleasing shape;

these I have adopted, and the result is a more pleasing specimen of gunnery than some of the uncouth masses denominated cannon.

After a perusal of this paper the board will see that my principles are few in number, though plain in fact; and if any theories more consonant with true ideas of gunnery can be produced, I should like to become enlightened on the subject, and hope that if the board reject my claim, they furnish me with an official copy of principles adopted in its designated models.

I hope the board will find no fault because I have omitted sending a description of the machinery used in raising and lowering the breech-block. I have not deemed it necessary, inasmuch as this part of a gun contributes nothing to any of its grand essentials.

Suffice it to say, that I shall move the block by a combination of well-known mechanical powers, allowing no complication to exist in any particular.

The peculiar mode of fitting my breech-block precludes that rapidity of movement possessed by some guns, and yet this is no drawback, as I sacrifice a little time to power and security, and yet can fire my piece as rapidly as is consistent with safety.

All well-known rifles have a peculiar projectile; mine is no exception to the rule—and I depend much upon the projectile for increased power of penetration. The projectile I offer to the board is conical-shape, steel-faced, and I claim the following advantages: It can be used either as shot or as shell, or as both combined, and in this last form I recommend it for adoption, for the following reasons: As a percussion-shell it will explode instantaneously, thus adding to the force of the blow at least one-quarter of the expansive force of the shell charge, (from 48 to 60 ounces quick-burning powder;) and this charge being far removed from the apex of the projectile, it is powerless to destroy the face of the shot, but will simply blow to pieces the entire base and sabot, thus leaving the penetrating power not only untouched but augmented. If in action against a wooden vessel, its immense superiority is apparent at once, for although fired by percussion, it can be made to explode while passing through a bulwark, or directly upon a gun-deck. Its superiority in long range can easily be demonstrated. If an elongated body, having an unequal weight at either base or apex, is fired at high elevation, the inevitable law of gravity will cause the heaviest end to strike first, not because the heaviest body will fall a given distance more quickly than a light one, but because the projectile in its flight describes the arc of a circle, and as the heaviest point is in front, by reason of its steel face and large shell cavity in its base, its natural tendency is a gradual depression of its apex. This hypothesis is made more certain from the fact that the unequal surface of the sabot, caused by the grooves, will allow and gather more atmospheric pressure than the apex; hence it is that a power exerted upon the base of a moving body tends to depress its apex.

These facts do away with all the old fuses, which, hundreds of times at Charleston Harbor, exploded their shells so prematurely as to render them perfectly harmless. It has been impossible to make all fuses with mathematical accuracy, hence a remedy is demanded, and I have given it.

The diagram explains both gun and projectile. This, with a model of the breech-block, will, I hope, prove satisfactory to the board; but if it does not, and the board will give me a short time, I will furnish a complete working model, and exhibit an approximate cost as furnished by the largest foundry in America, (Southwark Foundry, Philadelphia.) The theory I have advanced in favor of rapid ignition is, I know, a direct antagonist to old-time fallacies, and I think that it is time that some bold gunner should leave a path that has been worn bare, and seek a road that is more in accordance with the progressive ideas of the age. The almost irresistible expansive force thus generated must have an augmented power upon the projectile, and no gun that has ever been built can turn this increased power to the same advantage as my rifle.

At the time the board commenced its session I was wholly unprepared as regards models, cost, &c., and yet can say that I will, if directed, produce a gun of superior stuff and workmanship, at a cost as low as can possibly be made; or if the board has any designated foundry I will be content to furnish every plan and specification, and accept a royalty for the use of my patents. Hoping that success may crown my efforts, I will close, signing myself, gentlemen, your most obedient servant,

EDWARD WILER DUNLAP,

*Inventor, Patentee, and Owner of Dunlap Steel Breech-Loading Rifle,
and Conical-Shot and Percussion-Shell combined.*

HENRY DURELL.

No. 29.]

Compound sectional gun.

A steel or other metallic hollow cylinder surrounded with steel or other metallic disks held together by rods, bolts, or bars. Trunnions shrunk on the cylinder, or on

outside of the gun, the butt-end of cylinder surrounded with steel wire-rope, or water inclosed for re-enforce. If a square or triangular gun, the trunnions or substitute appliances to be secured to platform.

This construction may be applied to cylinders for hydraulic presses, steam-boilers, and steam cylinders; where great strength and resistance is required, very large shafts for propellers and other uses, reversing the disks that the fibers shall cross.

HENRY DURELL.

DANIEL FITZGERALD.

No. 19.]

NEW YORK, July 11, 1872.

SIR: Inclosed herewith please find letters-patent No. 121455, dated December 5, 1871, for "Improvement in submarine ordnance;" also, letters-patent granted for the United Kingdom of Great Britain, dated June 14, 1869, and numbered 1824. I also send a model field-piece or gun illustrating to some extent my said invention as described in the letters-patent herewith sent. I will at all times, upon request, attend your board and make such explanations as to my improvements in ordnance as the same may be susceptible of.

Yours, respectfully,

DANIEL FITZGERALD.

Care of Wm. H. Johnson, 267 Broadway, New York.

Colonel R. H. K. WHITELEY,
President of the Board of Heavy Ordnance.

[Inclosure.]

Daniel Fitzgerald's improvement in submarine ordnance.

Specifications forming part of letters-patent No. 121455, dated December 5, 1871; ante-dated December 2, 1871.

To all whom it may concern:

Be it known that I, Daniel Fitzgerald, of New York, in the county of New York, and in the State of New York, have invented certain new and useful improvements in submarine cannon or mortar; and do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawing and to letters of reference marked thereon, making a part of this specification.

The nature of my invention consists in the construction and arrangement of a vessel with one or more cannons or mortars, which will be partially submerged in water, and which can be made to throw shells or balls of different calibers.

In order to enable others skilled in the art to which my invention appertains to make and use the same, I will now proceed to describe its construction and operation, referring to the annexed drawing, which forms a part of this specification, and in which Fig. 1 is a side view of the vessel; Fig. 2 is a longitudinal vertical section of the same; Fig. 3 is a side view of a steel shaft, the use of which will be hereinafter fully set forth; Fig. 4 is a front view of the guns in the stern of the boat; Fig. 5 is a plan view of the same; Fig. 6 is a plan view of the vessel; and Fig. 7 is a longitudinal vertical section of the large cannon or mortar. A represents a vessel of any suitable size and dimensions, having a hole or aperture in its bottom. In this aperture is placed a large mortar, B, which is hung on trunnions having their bearings in the sides of the vessel A. The mortar is so arranged that it can be turned on its trunnions so as to be horizontal, perpendicular, or at any angle desired; and when placed horizontally it will fill up and close the aperture in the bottom of the vessel.

Usually mortars or cannons of very large caliber have to be very thick so as to withstand the immense pressure from the inside, but if such a mortar or cannon were partially submerged in water the pressure of the water on the outside would counteract the pressure from the inside to some extent, and hence the mortar need not be of such great thickness. For this purpose I place the mortar B, as above described, so that when it is to be fired at an angle, its breech, and in fact the greatest portion thereof, will be submerged in water, and the water itself receive the greatest portion of the concussion. I may not hang the mortar on trunnions, but have it placed stationary at a certain angle, if so desired. It will be seen that in either case the vessel itself, so to say, becomes the gun-carriage, and as both the gun and the vessel are in the water the effect of the concussion will be greatly lessened. Besides this advantage the mortar is kept constantly cool, and as a consequence can be fired with greater rapidity and for a longer period than is usually the case. To increase this cooling effect of the water I may perforate the sides of the mortar longitudinally either partially or clear

through, forming a series of passages, *a a*, in or through the metal, as seen in Fig. 2. Such perforations will not, as might be supposed, impair the efficiency of the gun.

If it is desired to use smaller projectiles another cylinder, *C*, may be inserted in the mortar *B*. This cylinder *I* cut with circular grooves its entire length, or place hoops or rings around the same at suitable distances apart, and provide with a lip or flange *b*, which extends over the upper edge of the mortar *B*, the main portion of the cylinder projecting above the same. Water is admitted between the mortar and cylinder, whereby the strength of both these concentric cylinders is consolidated and combined, and, at the same time, it keeps the inner cylinder cool.

In Fig. 7 I have represented the cylinder *C* with a series of concave circular grooves and rings, *c c*, put around the outside of a cylinder, *d*, which thus increases the strength of the gun, as the strain has a tendency to go off in two directions; and, besides, when the gun is immersed in water it will become cooled a considerable distance into the metal. I also provide a steel tube, *D*, which may be smooth or rifled, and is inserted into the cylinder *C*, its rear end being enlarged, as seen in Fig. 2, so as to form a chamber for the powder. The tube *D* extends beyond the front end of the cylinder *C*, and is, at its mouth, provided with an elastic steel ring, *e*, which rests against the outer end of the cylinder *C*. The size of the mortar *B*, cylinder *C*, and tube *D* should be such that when the mortar is placed horizontally the mouth of the tube *D* shall be flush up against the end of the vessel; that is, against the inner front side of the cavity in which the mortar is placed. Through the bow of the vessel is placed a steel tube, *f*, in such a manner as to form a continuation of the tube *D*, so that any projectile fired from the tube *D* will pass through the tube *f* and out at the bow of the vessel.

The tube *f* may be used alone as a gun, in which case I insert a shaft, *E*, Fig. 3, of steel or other suitable material, in the tube *D*, the front end of said shaft being even with the mouth of the tube. In the inner end of the tube *f* is inserted a plug or block, *E'*, which forms the breech of the gun, and is supported by the shaft *E*. A vent-hole, *i*, is then also provided. In the stern of the vessel are made two cylindrical openings, in which are inserted two guns, *F F*. These guns are made thicker or provided with rings or bands around the mouth and breech of such size as to fit exactly in the cylindrical openings in the vessel, while the center of the guns has a chamber or space around it, which is filled with water through an aperture in the upper side of the vessel. The guns *F F* may also have grooves, as seen in Fig. 5, for the same purpose as above described for the cylinder *C*. Around the mouths of the guns *F F* is placed a block, *G*, which connects the two guns together, and being secured to the stern of the vessel holds the guns securely in position.

It will be understood that I may use as many guns or cylinders, one inside the other, as may be desired, having water between them, and not confine myself to the specific number above mentioned.

It is well known that heavy guns, which must be of great thickness, are very liable to crack and burst; but by combining a series of guns, one inside the other, and the interstices filled with water, I get all the advantages of a solid gun of the combined thickness without the danger of bursting, as the water tends to consolidate and combine all the thicknesses, and, at the same time keeps it cool. Safety-valves are, of course, placed at convenient points, as well as inlet and outlet tubes, so that any steam that might possibly be generated may escape, and so that the water can be drawn off and replenished again. Another advantage of making a heavy gun in this manner, so to say, in sections, is that it can be far easier transported than if it was in one solid piece. The gun which I have represented in Fig. 7, having a series of conical or concave rings, may be used without water; and these rings may be of almost any shape desired, the more conical the better, and answer all the purposes of a solid gun of the same thickness, with the additional advantage of there being no danger of bursting, as the expansion of the metal tube has free room to go off without any injury to the outer circumference. These guns may then also be used as field-pieces, or be placed in some stationary battery, in which latter case I may also surround it by water, if so desired.

When the gun is placed horizontally in the vessel, the breech should come directly against the rear side of the cavity in which the gun is placed, thus taking off all effects of the concussion from the trunnions. When the gun is placed at an angle and consequently submerged in water, then the water receives a great part of the concussion, relieving the trunnions.

The gun or tube *f* in the bow of the vessel is surrounded by a series of rings, *m m*, made of steel or other suitable material. These rings are made in kind of zigzag shape, as shown in Fig. 1, and slipped over the gun and fastened together in any suitable manner, forming a part of the vessel, and may be of any diameter desired, so as to form, in fact, a gun of enormous thickness. The rings *m m* being of the peculiar shape above mentioned, will allow for any expansion of the gun itself, without any danger of breaking or bursting.

I am aware that guns have been made of a series of straight rings secured together, hence I do not claim such to be my invention.

DAN L. FITZGERALD'S SUBMARINE CANNON OR MORTAR.

Fig. 6.

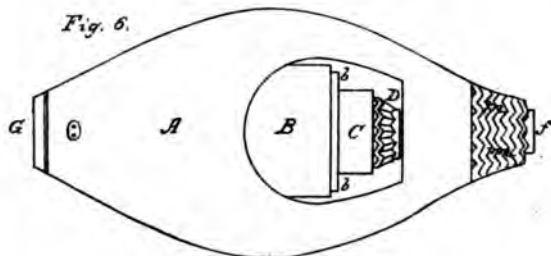


Fig. 7.

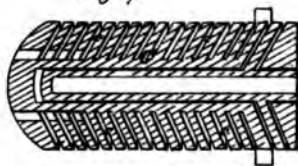


Fig. 1.

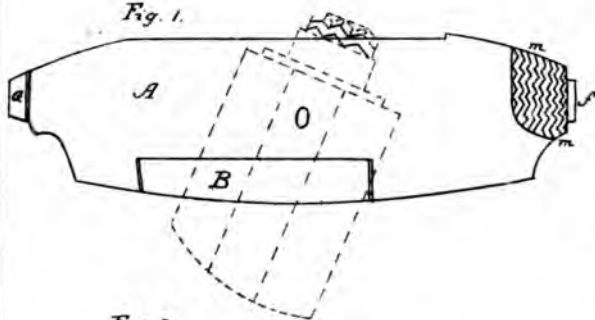


Fig. 2.

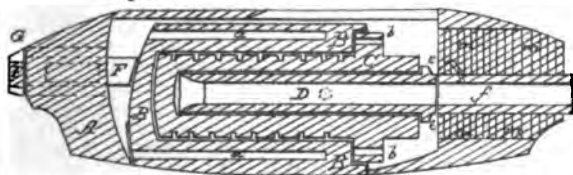
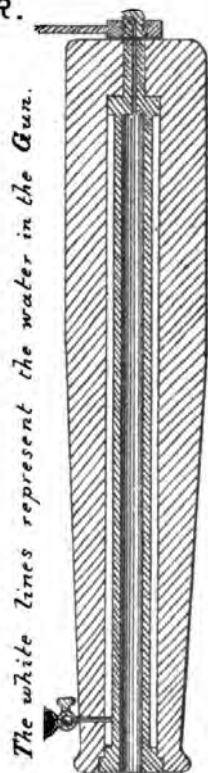


Fig. 3.

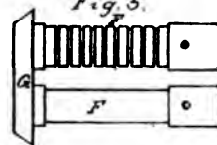


The white lines represent the water in the Gun.

Fig. 4.



Fig. 5.



Having thus fully described my invention, what I claim as new and desire to secure by letters-patent, is—

1. The mortar B, hung on trunnions or stationary in the bottom of the vessel A, so as to be partially submerged in water while it is being discharged, substantially as and for the purposes herein set forth.

2. In combination with the mortar B, the cylinder C, constructed and described, and the space between the two filled with water, substantially as and for the purposes herein set forth.

3. The combination of the mortar or gun B, one or more cylinders C, and the tube D, provided with a zigzag or corrugated flange, E, all constructed substantially as specified.

4. The arrangement, with the vessel A, of the mortar or gun B, one or more cylinders, C, and the perforated bow *f* forming an elongation of the gun, all substantially as set forth.

5. The gun herein described, composed of a series of conical or zigzag rings surrounding a central core, substantially as set forth.

In testimony that I claim the foregoing, I have hereunto set my hand, this 22d day of April, 1869.

DANIEL FITZGERALD.

C. GAGSTATTER.

L. B. No. 45.]

ARMY BUILDING, NEW YORK, August 7, 1872.

SIR: Your letter of the 21st ultimo to the Chief of Ordnance has been referred to the board on heavy cannon. I am directed to inform you that the board invites you to lay before it, as speedily as practicable, such drawings as you may have, and such further information as may serve to explain your plans for constructing heavy cannon.

Very respectfully, sir,

C. E. DUTTON,

First Lieutenant Ordnance, Recorder.

C. GAGSTATTER, Esq.

No. 100.]

Materials for the construction of cannons.

Before describing my breech-loading system, I will advance my opinion as to the above subject, which I gave also my attention, by studying the tests and contests in the principal European artilleries, of which only those of England and Prussia are to be regarded, as all others did not do much in this matter, but rather followed either one of the other named States.

As materials for constructing cannons we have only to consider iron in its three varieties, "cast iron, steel, and pure malleable iron." Bronze has been condemned, and so ought to be cast iron, unless in combination of one of the other sorts, or as alloy with some other metal. Steel is the most favored on the European continent, while England holds to pure iron, (Armstrong and Fraser.) Krupp and Armstrong were alternately ahead of each other in constructing heavy ordnance until 1863, when the Prussian government ordered another contest between Krupp and Armstrong's cannon, in which Krupp's proved much superior to Armstrong's. Both were breech-loaders, and shot a 600-pound projectile each.

They began the test with one-half increased charges, and the second shots were even double charged, and that proved more than the Armstrong could stand, while the Krupp bore yet many more. (I forgot the number, and I could not find the report of this contest, which I received from a Prussian officer.) Thus Krupp was master, and experts attributed this victory to the new process of Krupp in treating the steel block, which is to form the cannon, with his world-renowned steam tilt-hammer that gives his steel so superior qualities above all others.

As evident, this victory appeared to the Prussian government, it does not seem so to me, because this contest was only between two pieces, and just that special piece of Armstrong may have been a failure, and besides that the difference in the breech-system may have some influence too; in fact, it has one.

Further, this victory was sufficient for the Prussian government, because such contests with 600-pounders are very expensive, and cannot be often repeated, and then was the Prussian artillery extensively experimenting on iron-clads for the navy, at the same time. Now I will admit that Krupp's steel cannons have superior qualities in comparison with Armstrong's or Fraser's, but I maintain that especially Fraser's manner of constructing cannons is the most practical, and so I will prove now.

At a previous time, 1866, when the English government ordered a contest between Armstrong's and Whitworth's guns, both pieces were 70-pounders, the weight of their projectiles 150 pounds, and both bore up to 3,000 shots. Whitworth was a steel cannon,

and all experts must acknowledge the extreme accuracy with which Whitworth's cannons are made, and also the good qualities of his steel, and yet he could not do better than Armstrong.

Now if we compare this contest with the former, we see a striking difference; and as I cannot believe that Krupp's steel is considerably superior to Whitworth's, you will come perhaps to the same conclusion in regard to the first-mentioned contest as I, and then admit that Armstrong's system is preferable for its being cheaper, if even Krupp's steel is superior, but then also much dearer. And again, as Fraser's system is similar to Armstrong's, but much cheaper than his, without being inferior in solidity, we must come to the conclusion that Fraser's cannons are the most practicable.

Fraser's cannon of great caliber costs £40 per ton in England, while a common cast-iron cannon costs already £30 per ton. I did not hear of more tests or contests of heavy ordnance, since 1869, except the Franco-German war, in which Krupp's steel cannon proved a decided success.

Russia made experiments with steel muzzle-loaders, and it was found that these stand only 250 shots at an average, while at the same time a steel breech-loading 9-inch cannon bore 1,000 shots, and that is the reason why Prussia, Russia, Austria, &c., accepted the breech-loading system entirely.

I have yet another fact on record, which approves my above-expressed opinion of Fraser's cannon, and that is Austria accepted Krupp's steel cannon for her navy, and supplied it with that up to 1870, when she commenced to introduce Armstrong's or Fraser's, although I cannot say whether she continued so since.

The French artillery never experimented much with its heavy ordnance, nor did I ever hear of a contest with other systems, except the late war, and that proved not to its advantage. What we saw at the Paris exhibition in 1867, was not worthy of consideration.

In regard to cast-iron cannons, strengthened by pure iron rings, I must say that they don't answer the purpose, as was proven by numerous tests; but Palliser's alteration of forming the inner part of the cannon of the stronger metal, as steel or pure iron, and cast the body of the cannon around of cast iron, was a success; although such cannon cannot be compared with either the Krupp's or Fraser's.

We may yet expect an improvement in cast-iron cannons by forming an alloy of cast iron with some other tenacious metal, but after all I think that Bessemer steel or pure iron, well hammered in block, will prevail as material for heavy ordnance.

As I have not the time now to enlarge on this subject, because I am to write to Europe for reports and facts of later experiments in that line, I must close this article with the remark that I find it strange why they take cannons of so large a caliber in order to find out which material is better; would not 6-pounders answer as well?

C. GAGSTATTER.

Which is the best breech-loading system?

I say, that which allows the quickest possible shooting, which has at the same time the greatest solidity, and which with the whole cannon does the least exceed in weight a muzzle-loader.

The first question may be answered by a comparison of my system with all others practically existing now. The second question I answer with the "screw-breech." The last I answer also with the "screw-breech," as a mere glance at my figures will show and practice prove.

That a screw-breech offers the most resistance is self-evident to every expert, because the reaction of the shot is not only divided on two points, as in Krupp's breech-loaders, or on a part of the circumference of the barrel, but on the whole circumference, and then we can make the worm of the screw as strong as may be required, and this will always be the strongest of all possible breeches occupying the same length of the barrel as the screw-breech. This is an indisputable fact, which to prove I hope will not be necessary.

Referring again to the contest between Armstrong's and Whitworth's 70-pounders, I will mention that it was screws that resisted the 3,000 shots.

Now a common screw-breech would answer well enough the second and third of the above questions, but not at all the first; and to make it also answer the first question I studied as long till I invented the conic-screw breech. As simple as this appears to be, it is not an easy matter to construct it proper, and also not any conic screw will answer. There are propositions and rules which must be observed.

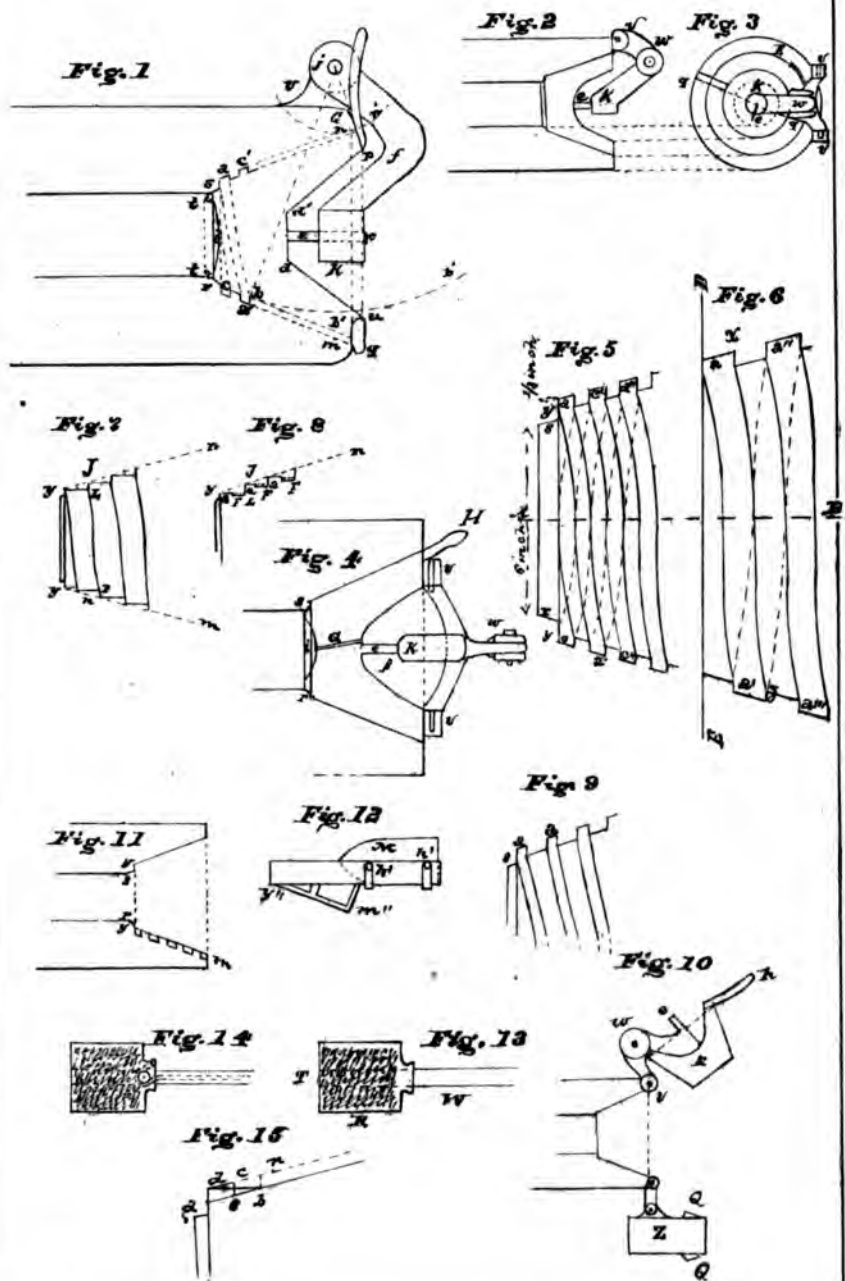
The principles of this system will be explained in Fig. 1; the following figures represent details. (See drawings.)

Fig. 1 shows the whole arrangement seen from above, the cannon being cut horizontally.

In order to open the breech as quick as possible, the worm of the screw is so calculated that the screw will be free and loose after half a turn, and be ready to be turned aside.

THE CONIC SCREW BREECH

BY C. GAGSTATTER.



The screw in Fig. 1 has two worms, one commencing above at *i*, going to *c*, and around below to *c'*, and so on; the other commences at *i* below, and, going to *a*, winds over to *a'*, &c. If we take now compasses and measure the distance from the center-line to *a*, turn then the compasses around toward *a'*, representing "the half-turn" of the screw, we will find that the worm has left the groove, and thus can be turned aside.

It is self-evident that the whole worm around the screw leaves at the same moment its groove.

To facilitate the turn of the screw we fasten a handle *h* to it, or H Fig. 4. As the breech is supposed to be of good steel, we can safely excavate it in the back and toward the charge, as shown by the lines *p d' u*, in the back, and *t i t*, toward the charge. You will also observe that the lines *p d'* and *u d* are pointing toward *t t*, which I think proper.

In order to keep the axis of the breech in the center line of the bore we employ an arm, *f*, which has a hinge at *o* fastened to the body of the cannon, turning around *j*, and which forms at *k* a case for an axis, *e*, of the breech by which this rests on the arm during the motions. Now it is evident that as soon as the breech is a little turned it will solely rest on the arm *f* for the conical shape of the screw, and therefore we will only have to overcome the friction of the axis *e* after we bring the breech in motion.

In order to turn the breech aside without impediment, after it was freed, we will have to fix the point *j*. This can be done by drawing a line normal to the line *a n* of the cone from the end of the bore at *n*. Farther, when we turn the breech half way the part *a* of the worm will have its groove at *b*, and as the part *a* will be the most distant point from *j*, we will have to draw a line normal to *b b'* from *b* toward *j*, and where these two lines cut there will be the wanted point, *j*.

Now we are able to open the breech.

To facilitate the insertion of the charge into the barrel it is good to make the bore a little conical at *r s*. See Figs. 1, 5, and 11.

t t shows Broadwell's ring, which closes the bore air-proof.

If the hinge should be found too much exposed we may place it to *r*, in Figs. 2, 3, 4, and 10, but then there will be necessary another hinge in the arm *f* at *w*. See Figs. 2, 3, 4, and 10.

It must be observed that equal letters signify equal parts in all figures.

Fig. 10 shows the breech opened, seen from above. Now we have yet a very simple arrangement at *g*, in Figs. 1 and 3, by which the worm of the screw is bound to catch at once its groove when we are closing the breech; *g* is a strong cog on the breech which strikes against the arm *f*, in Fig. 3, at *g'*, the same moment when the worm leaves its groove. When we close the breech we will have our hand resting at the handle, (see Fig. 10,) and bring the breech in its due position, and then turn it around, by which it must catch at once.

By the arrangement of the arm in Fig. 2 it may prove necessary that the part *v w* dare not move farther against the left side of the cannon than it is when the breech is closed. This can easily be accomplished by the part *E* in Fig. 3, which is in connection with the arm, and rests on the bottom of the cannon. In Fig. 1 we need not to provide for that, as the arm *f* will rest at *G* on the cannon any way. In Fig. 5 we see the screw-breech of Fig. 1 enlarged. The dotted lines show the way of the worm on the other side.

On applying compasses we can easily find that all points of the worm will leave the groove after one half turn.

The gradation of the worm in Fig. 5 is at the beginning 60°, and becomes less yet toward the base. The longer the turn the higher we may make the worm of the screw.

A, B is the center line of the bore. Fig. 6, on the right side of the line D, E, is a continuation of the cone in Fig. 5, but representing a single-wormed screw, which, by the same gradation of the worm, will be freed after one half turn. Measure the distance from the center line to *x*, and then from the center line to *z*, it will be found that the screw is freed. I would give the double-wormed screw the preference.

In Figs. 7 and 8 we have another form of a screw-breech, which, in view of solidity, I would prefer to all others, but I fear it will be rather difficult to construct such screw with the due exactness. Such screw would be always best one-wormed. In Fig. 7, *n y y' m* means the outline of the cone. The next to do would be turning the cone like a fusee in a watch, and after that is done we turn the groove F F in Fig. 8, by which again the worm *a* is formed.

If we want such screw to be freed after one-half turn the groove dare be made only half as deep as L J, in Fig. 7, while the width *y L* will have to be proportional. I consider this system the only possible one to transform muzzle-loaders into breech-loaders practically.

As we can make the breech of the best steel, we can make the worm of the breech as much narrower, Fig. 9, than that in the barrel, as the metal of which the barrel is constructed is weaker than steel. Thus we make the best use of this system.

In Fig. 4, which shows the breech arrangement seen from the *left side*, G is the touch-hole which leads to the center of the bottom of the bore, in accordance to my article "how to give projectiles the greatest velocity." As I would not consider a cannon perfect without an arrangement to fire with percussion-caps, we have space enough in the excavation of the breech to fix one, and to facilitate that we may take off the edge of K at B, as required.

In Fig. 11 we see that the end of the bore is a little widened at *r s*, and also that the head of the breech is a little wider than the mouth of the bore, in order to facilitate the insertion of the charge.

Fig. 12 shows a gun-ladle for heavy ordnance; *h' h'* are the handles by which either two or four men carry the projectile M. The arrangement *y'' m''* is not very necessary if the men are exercised, and hold the back end a little lower on introducing it into the barrel until the part *y''* pushes against *r*.

In order to speed the act of loading in battery-cannons, I thought of fixing the ladle to the cannon, Fig. 10, Z, on which the projectile could be laid while the breech is to be opened, and could then be turned in in a similar manner to the breech, guided by Q Q; but this would complicate the matter too much without corresponding advantage; therefore it is best to leave it off.

In small cannons we can insert the charge without any ladle by holding the projectile in the left hand, introducing it into the back of the conic part of the barrel to the proper place, and pushing then the projectile with the right hand into the barrel. The left hand may rest at the same time on the worm of the cannon.

In regard to cleaning the bore after shots, I must remark, that this can be done with the common brush; but if there is much dirt in the bore we will have to take care that this does not come into the windings of the screw, as this may hinder the closing.

In order to avoid that we will have to insert the brush and turn it at the same time screw-like as far as the charge reaches, pushing it through the bore, and pulling it out rapidly. Or we may employ a cotton brush or wiper, which keeps the dirt. Such I saw in the French and Prussian navy. Or, at last, we will have to construct the cannon-brush, as in Fig. 13, that is, with a case of plate-iron or copper, R; T the brush; W the stick. This case is fitting to the bore, and rather a little larger. When the brush is pushed into the bore another man holds the case in its place, and when the brush is pulled back this will take up the dirt. The case may be hit by musket-bullets; or else defective, it will answer as long as the brush does.

If this arrangement should be accepted, and we would like to spare the man for holding the case during the act of brushing, we can accomplish that by making a bore through the whole length of the stick, and introducing into it an India-rubber line, which runs near the brush over a roll, Fig. 14, and is fastened to the case. The working of this arrangement is evident.

The end-question now is, "Are there turning-machines for manufacturing such screws with the proper accuracy?" If not, I will invent one in due time, provided that my breech-loading system finds approval.

If we compare my system with any one now existing, and if I had the time to write more on this subject, to compare it not only with the existing but *all possible* systems, we would find that mine allows the quickest opening and closing, and as the projectile and charge is brought at once at its place, the act of loading will be effected in the shortest possible time. We open and close the quickest because there are only two motions, which are the easiest possible to perform; because they are around axis, and therefore we are enabled to shoot the quickest. This system has also the most excellent property of allowing the charge to be "set," that is, pressed into the barrel by the breech, especially then when we employ projectiles with lead rings.

If I would not abhor to complicate the breech more, I could reduce the motions of opening and partially also closing to only one.

I have already explained that a common screw-breech is the most solid one, but I can prove that my conic screw-breech is yet more so, because, by equal lengths of the screws, mine will have a much longer worm.

Supposing the reader is acquainted with the French breech-loading system, I will mention what frigate Captain Ziegler, of the Austrian navy, says about it:

"If at all the material (cast iron) is considered sufficiently solid, there is no objection against this breech-loading system, (with which I am also related,) because the barrel is less weakened than by Krupp's or Armstrong's, as it has no bore in a cross direction."

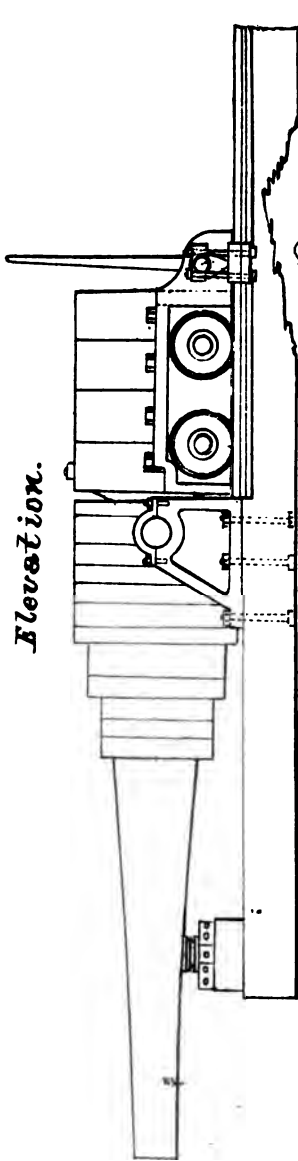
Now it is evident that my breech must be more than twice as solid, because, in the French breech, the worm of the screw is cut out on corresponding parts so as to enable the breech to be inserted for its whole length, and but then it is turned for one-fourth.

Now, I hope this will be found well studied, and will also find the deserved approval, as it is to my notion the best possible system of breech-loading, and, if accepted, you may expect much on that subject out of my pen, of no less importance.

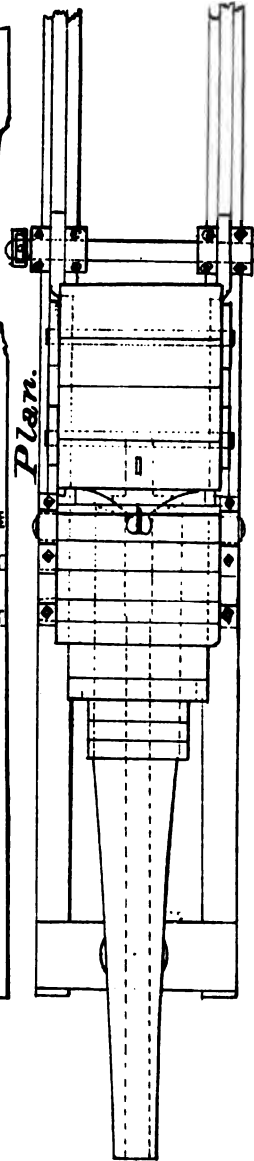
C. GAGSTATTER,

705 Chestnut street, Saint Louis, Missouri.

Elevation.



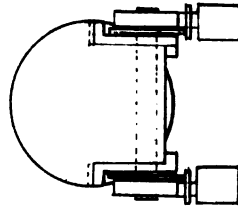
Plan.

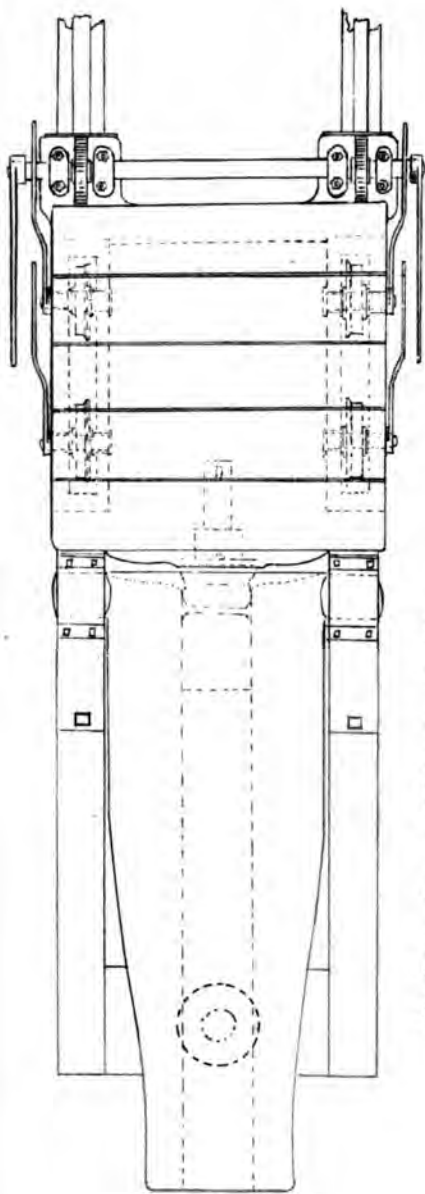


Powder Cartridge.

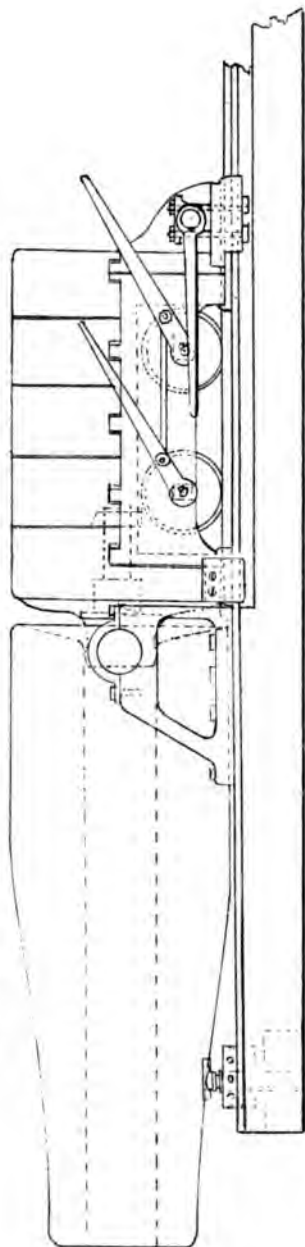


*Henson's
Breech Loading Gun.*





*Design for a 15 inch Gun...
Henson's Patent.*



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Appendix.—I forgot to say in the proper place that $1\frac{1}{2}$ caliber-space for the breech will answer all purposes.

The divergence of the cone will be dependent from the thickness of the body of the barrel.

The more we increase the gradation of the worm of the screw the stronger we may make the worm, but that is limited. The measures for the worm of the screw I find as follows: Reckon the half circumference about 1 inch or so off from a , of the cone, Fig. 15, and reckon with 5° or 6° gradation the highness of the half winding, and be this for instance from d to b , then will be ad the highness of the worm of the screw; then take the middle of bd , draw ce , and we have the cross-cut of the worm of the screw, ace , that is of the double-wormed one. For the single-wormed one the reckoning is the same, but the cross-cut would be $adnb$.

HENSON'S GUN.

No. 91.]

OFFICE OF MERRITT W. GRISWOLD & Co.,
104 Chambers street, New York, August 14, 1872.

DEAR SIR: I beg leave to submit herewith a drawing (a gun will be also submitted if desired) of "Henson's breech-loading and breech-recoiling gun," that in *actual practice* has given results superior to a solid gun of the same caliber, and accomplishing much beyond the impressions formed by a theoretical examination.

At each discharge the butt recoils from the barrel proper, which latter does not appear to receive the least shock, thereby leaving a clear open space for reloading.

A trial was made of placing an independent paper wad between the powder and breech, and it was left in the same position after the discharge that it occupied previously, though the shot had been projected with great force and the breech recoiled to its proper position for reloading.

Hoping to hear from you, I remain yours, &c.,

MERRITT W. GRISWOLD.

General R. H. K. WHITELEY,
President Board on Heavy Ordnance.

P. S.—Have working drawings for 15-inch gun.

No. 102.]

OFFICE OF M. W. GRISWOLD & Co.,
New York, August 22, 1872.

GENTLEMEN: I desire to call your attention to a few points relative to the "Henson gun," some of which were spoken of by individual members at the time the rough model was presented.

1. It opens a field for investigation by its introducing a *new principle* in heavy ordnance.

2. A gun of this form *separates* the two strains, can be made of almost unlimited size, and gives a perfect control of the recoil.

3. A more perfect burning of the powder is secured, and each discharge opens the bore from muzzle to breech, for the admission of cool air, and for entering the next charge.

4. The full force of the powder is exerted upon the ball before the breech recoils. This was proved by the penetrating force of the discharged ball; also by the fact that the gas check or wad, placed between the recoiling-breech and powder, remained in the same position after the discharge that it occupied previously, showing, conclusively, no gas or explosive force escaped, and that the ball must have passed out of the muzzle before the breech recoiled.

5. It can be fired at any desired angle, (the model does not show this,) and with the greatest rapidity, as there are no moving of parts, before or after the entering of each charge.

6. As the barrel does not recoil, the officers and men are protected from stray (or well directed) shots through the ports.

7. The construction of the gun allows the maker an opportunity of taking advantage of the highest point attained in the scientific knowledge in the working of metals.

At a trial made before some of our most prominent engineers, (outside of your immediate profession,) it was pronounced a most perfect success, in every particular, and in many points surpassing all other guns where an extremely heavy caliber was required.

The first gun, of the required size, with a steel or iron rifled barrel, will be made for

\$50,000; after that at such price as may be agreed upon, or at a royalty of one cent per pound.

Hoping the Henson gun may be selected by your board of examination as one of the number for trial,

I am yours, respectfully,

MERRITT W. GRISWOLD.

COMMISSION ON HEAVY ORDNANCE,
General R. H. K. Whiteley, President.

ALONZO HITCHCOCK.

No. 30.]

NEW YORK, July 17, 1872.

GENTLEMEN: I herewith submit drawings, specifications, and evidence of my plan for constructing heavy ordnance.

Very respectfully,

ALONZO HITCHCOCK,

No. 408 West Fifty-fifth street, New York City.

The Hon. BOARD ON HEAVY ORDNANCE.

[Inclosure.]

Improved process of forging wrought-iron or steel cannon.

In presenting an improved plan or process of forging cannon, it may be deemed necessary to state a few facts in relation to some of the important results obtained by my process of forging large masses of iron.

For reasons perfectly well understood by all scientific and practical iron-workers, it has been heretofore impossible to forge a cannon by any known process without destroying the tensile strength of the wrought iron, it being impossible to heat this enormous mass of iron, consisting of several tons, to a welding heat throughout the whole mass, without keeping it in a candescent state for many hours, when it is well known that the best wrought iron undergoes a total change from the fibril to the crystalline state, totally unfit for the use intended.

But it needs no further proof of the necessity of some improvement in the mode of forging cannon, when we know that all attempts heretofore have proved *disastrous and signal failures*, without exception. [This was written in 1856, since which time there have been slow but positive and in some cases satisfactory improvements.]

Prominent among the inventors in this line are Sir William Armstrong, Mr. Whitworth, and Mr. Krupp.

In 1859 I had occasion to dispute Sir William Armstrong's claims, which I did in the following article, addressed to the Chicago Daily Herald:

The Armstrong gun not a new invention in this country.

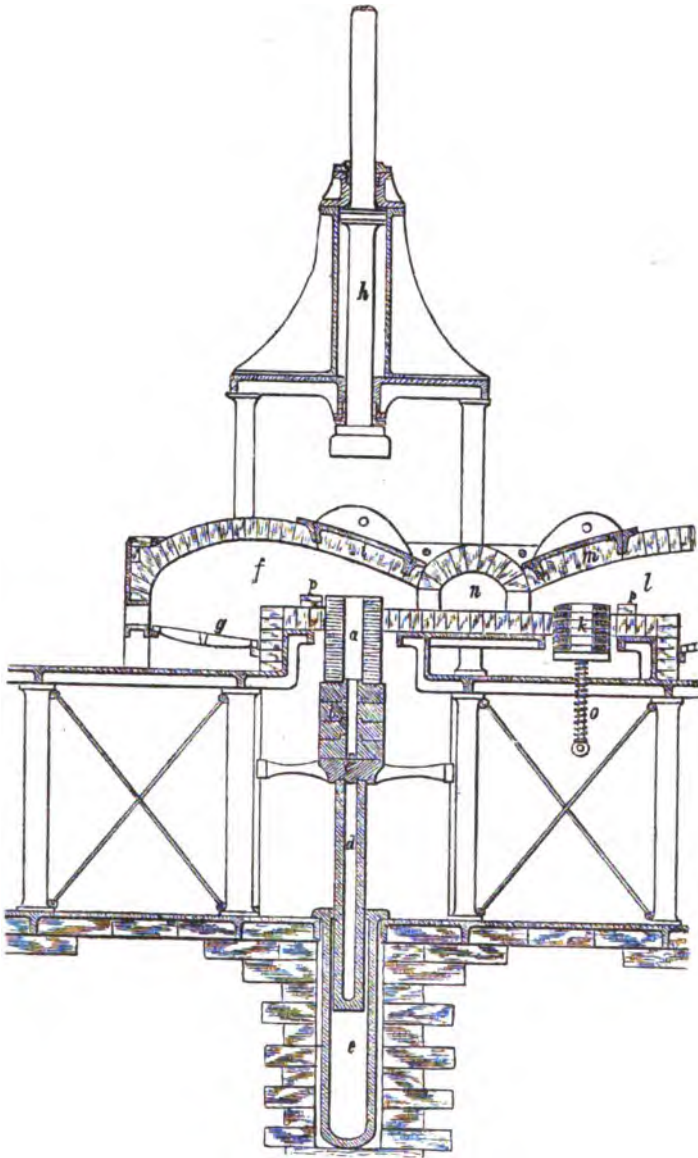
'Ever since the extraordinary efforts made in France and England to improve their cannon, we have been fearful that our country would be left entirely in the lurch in these improvements, as the whole patronage of those governments has been brought to bear upon this subject, and not without good results, as was sufficiently demonstrated by the French gun in the late war, and England now claims that they are about to produce a still better one.

Be this as it may, we are now satisfied that we are not only up to the time in our country, but that we can produce a gun far superior to either of the above, and never could an invention of this magnitude be more opportune. Below we publish a communication from Mr. Hitchcock, of this city, and we will say here that we have examined the whole details and process by which these results are attained, and, so far as our judgment goes, are perfectly satisfied that it has all the merit that is claimed for it. Though we don't profess to be practical or scientific in such matters, the whole process strikes us as being at once so simple and plain that there can be but one opinion expressed upon its merits; and we do not hesitate, unconditionally, in recommending our Government to take up this improvement and give it a fair test, especially as it is attended with comparatively but very little cost.—[ED.]

To the Editor of the Chicago Daily Herald:

Doubtless your attention has frequently been called to the late improvement in cannon, both in this country and in Europe, and prominent among the late improvements is the Armstrong gun.

Fig. 182.



It is claimed for this gun that it is the most perfect and most effective gun that has ever been invented, and it has already earned a knighthood for its inventor.

But in order to show you that it is not new in principle of construction, I propose to give you my little experience in this class of guns. Some sixteen or eighteen years ago, when Captain Stockton proposed to forge his big gun of wrought iron, my attention was particularly called to this subject of welding large masses of iron, not that there was any prospect of success in forging this gun as proposed, but from certain well-known practical difficulties it must inevitably prove a failure, as it did. It was very easy to tell how it could *not* be done; but to tell how it *could* be done was strictly a personal question, which I immediately set myself about to answer, and really I found so many difficulties in the way that I tried many devices to avoid the necessity of welding such large masses of iron, as for cannon, only one of which I will describe here, which will go to show at least an extraordinary coincidence.

I proposed then, in order to combine the greatest amount of strength with the least amount of material, to form a tube of suitable dimensions, either of wrought iron or cast steel, around which I propose to shrink a series of heated bands, from end to end, when another tier of bands would be shrunk over the first, so as to break joints, and so on until the desired strength be attained.

Here, then, we have the Armstrong gun, practically and substantially the same, the only difference being in the manner of hooping or banding this tube, Sir William Armstrong using a continuous band or bar of iron wound on hot from one end to the other, and then back, and thus continued until sufficient strength is acquired. Which of the two plans is the best could only be known by practical test, which I feel no interest in now, as I think now as then that there are *some* doubts about the practicability of either invention under extraordinary circumstances, not necessary to mention now; and inasmuch as there were some doubts in my mind about this mode of construction, to say nothing about the expense, I did not feel at liberty to bring it forward; besides, I was constantly under the impression that the great problem, how to forge large masses of wrought iron or steel without injuring its quality in a single point, could be solved.

Accompanying this, you will find drawings and models of my process for forging large masses of iron or steel, or both combined, and I will leave it to you to say whether or not I solved this problem satisfactorily.

I propose, then, to forge a gun of wrought iron or cast steel—or both combined—as, for instance, the lining the inside of the gun with steel, or welding on a steel breech after the barrel has been bored and rifled, of any given weight from ten to twenty tons, without the least possible chance of a flaw or imperfection. In short, I can forge any amount of wrought iron or steel, as in guns or shafting, into one solid homogeneous mass, when every part and parcel of said mass shall be as perfect as the best hammered iron or steel, and more perfect in its texture and tensile strength than the best rolled iron of commerce, and this can all be done by one man if necessary. Being able to accomplish all of this, I am prepared to make a gun as much superior to the Armstrong gun as the Armstrong gun is superior to the ordinary gun, far superior in strength and durability, lighter, and at least 50 per cent. cheaper!

ALONZO HITCHCOCK.

CHICAGO, August 9, 1859.

It would seem by this communication that I fully comprehended the "situation," which Sir William did not comprehend, as is shown by his subsequent and continuous experiments up to this day.

In submitting my proposition to the board, I stated that I submitted drawings, specifications, and evidence that my principle of forging cannon is correct, which I shall endeavor to show.

My first evidence will be found in Mr. Alexander L. Holley's Treatise on Ordnance and Armor, in which he so admirably and ably illustrates and describes my process. I therefore transfer the whole of his article to these pages with accompanying cuts of the forge.

"To carry out, in the fabrication of large cannon, the principles of sound welding considered above, Mr. Alonzo Hitchcock, of New York, proposes the system illustrated by Fig. 182. The iron is heated in a reverberatory furnace, to avoid its contact with sulphur and other impurities of coal. The gun is formed of rings of wrought iron or low steel made without welds. The rings are so formed as to be united first in the center, that the superfluous cinder may be squeezed out. The anvil (*b*) is seated on the piston of a hydrostatic press, (*c*), so as to be lowered as the successive rings (*a*) are added.

"The furnace (*f*) is situated between the anvil and the steam-hammer (*h*) and so arranged that the rings project into it from below and the hammer drops into it from above.

"The ring to form the muzzle of the gun is laid upon the movable anvil and pressed

jected sufficiently into the furnace to allow the flame to raise it to the welding heat. Meanwhile, in another part of the furnace, the rings (*k*) are heated to welding in the same time, by proportioning the heat, by means of dampers,, to the relative bulks of the two parts. Without removing the parts from an atmosphere in which there is very little, if any, oxygen, they are laid together and instantly welded by a few strokes of the steam-hammer. The anvil is then lowered by the thickness of another ring, and the same process is repeated. Although the *gun* may be of any size, the parts actually united at one operation may be made so light by reducing their thickness that the pressure of a hammer of moderate weight will be adequate.

"And when the whole operation of upsetting is confined to one joint, exactly the requisite pressure for that joint can be applied, and there is no fear of injuring other parts by setting it up soundly, because the mass of the gun below it is cold and forms a rigid pillar, practically a continuation of the anvil.

"The blows upon the end of the Armstrong coil have to weld a great number of joints; those next the anvil, and those that from bad fitting require the most pressure, are not always set up until other parts of the tube, which is a long column softened by heat, are bulged and disfigured. To avoid destroying the tubes in this way, they are made in short lengths, which have to be joined by a subsequent process at a considerable cost. Even these are bulged, and have to be restored to the cylindrical shape by 'patting.'

"It would appear that all the conditions of sound welding may thus be obtained if the process can be practically carried out. The objection raised by some iron-workers, that the single ring will be burned before the larger mass is heated to welding, is not well founded. Certainly the heat in what are substantially or may be practically two different furnaces can be regulated with the utmost nicety. Besides, the mass is already hot before the ring to be added is put into the flame. Locating an anvil upon water is simply a question of the strength of what holds the water. A screw would answer the purpose and would not be liable to derangement, since an accurate fit is not important, and the adjustment does not take place at the instant of the blow. Or the screw might be employed simply to elevate and depress the anvil, the force of the blow being received by blocks of varying thickness, placed between the anvil and its bed.

"The mechanical difficulties do not appear to be serious, and a considerable cost of apparatus is warranted by the certainty of sound work. The expense of dressing the ends of short tubes by the Armstrong process, and of making colossal furnaces and hammers to heat and condense a 30 or 40 ton forging to the core, is dispensed with. Indeed, the furnace may be a little larger than that employed for gas-welding the Armstrong tubes.

"Mr. Hitchcock's process was intended especially for fabricating guns of low steel, the rings to be made without welds, by being originally cast in the form of small thick rings and then rolled, in a modification of the tire-rolling machine, to a larger diameter and a smaller section. This treatment would develop an endless grain in the rings in the direction of the circumference. * * * Again, very short Armstrong coils could be welded together by Hitchcock's present process."

Mr. Holley also says, on page 382: "Cast iron, cast steel, and bronze may be welded at a melting heat; but, although wrought iron cannot be melted at a practicable heat, every iron-worker knows that it can be treated so as to have as much strength at the weld as elsewhere, and sometimes more strength, because the iron at this point is better worked.

"Hence it appears that, although in the general practice welds are treated as weak points, and a still further allowance is made, especially in large forgings, for actual seams or flaws, there is no physical law against sound welding if iron and iron are brought together at a proper heat and under the proper pressure."

The only thing new that I could suggest or alter after so many years have elapsed in my first conception of this plan of forging would be simply to change the reverberatory furnaces to gas-furnaces, which I think would be cheaper, and certainly much more convenient.

Further evidence of the practicability of my principle of forging.

The joint committee appointed under the resolution of the Senate and House of Representatives of the 30th of March, 1867, to investigate the purchases, contracts, and experiments of the Ordnance Department, having completed their labors as far as relates to experiments on heavy ordnance, submit the following report thereon:

TESTIMONY RELATING ONLY TO WELDING.

Timothy A. Hunt, commodore, U. S. N.

36. Question. What was your conclusion in regard to the principle upon which Mr. Ames has been manufacturing these wrought-iron guns?—Answer. I think his princi-

ple is the best we know of at the present day; think it will make the best gun. I think it is a much safer way than welding them in coils as the Armstrong and other guns are made.

Theodore T. S. Laidley.

59. Q. Is it possible, in your opinion, to make a weld of a wrought-iron gun so perfect that it will not be a weak spot in the gun?—A. I think it can be done.

60. Q. What do you think, then, of the principle of manufacturing guns as Mr. Ames has undertaken it?—A. I do not know whether Mr. Ames can make a perfect weld uniformly or not in such large masses.

89. Q. Do I understand you to say this Ames gun is the strongest that you have ever tested, tried, or know anything about?—A. When the welds are well made it is the strongest gun I have ever known.

Q. A. Gillmore.

58. Q. Give your opinion generally about the use of wrought-iron guns and their value as compared with cast ones.—A. A wrought-iron gun, in my opinion, if made by this process of welding rings together, which is Mr. Ames's patent, and we can get a gun without defective welds, would be one of the most valuable guns we could have; and I believe that a defective weld would be developed in proving a gun. If it does not break in the proof charges—say eight or ten heavy charges—I should regard the welds good.

Isaac French, (forger of Ames's guns).

11. Q. Will you state briefly the manner in which the guns (Ames's) were manufactured, &c. ?—A. * * * * * There were three rings, thus: one inside of the other. The middle ring, which is ten inches in diameter, projects about five-eighths of an inch from the other on the side that goes on to the gun. The object of this projection is to have it strike in the center of the weld, the center of the gun first.

14. Q. When the weld is perfectly made, is there any weakness at the welding point?—A. I do not see why there should be, any more than at any other part of the gun.

15. Q. Is it as strong there as at any other portion of the gun?—A. I do not see why it is not.

16. Q. Did you have any failure to make the welds during your experience?—A. No, not on the guns that I made.

17. Q. Did Mr. Ames, in making any guns, fail in making a weld at any time?—A. We tried various experiments, and sometimes the welds were not perfect.

18. Q. But, after the system was perfected, you think the welds were such as could be depended upon?—A. I think the eleven guns were perfect welds, and were as solid there as anywhere.

Mr. James Wilson, (foreman and forger at the Washington navy-yard.)

5. Q. Are welds, when perfectly made, as strong as any other part of the iron?—A. Yes; I think they are quite as strong.

6. Q. What is your opinion about the possibility of making perfect welds in large masses of iron, if you have suitable tools and furnaces?—A. I think you can do it and make them perfect.

7. Q. You have heard the system of manufacture described here of Mr. Ames's gun?—A. Yes.

8. Q. Will you state if you have any doubt that the welds could be made perfectly by that system?—A. I have no doubt in the world; I believe it can be done.

9. Q. Then you think there is no reason why large masses of iron should oxidize so as to prevent welding, if only skillfully and properly manufactured?—A. None in the world.

10. Q. Will not large masses of certain iron be longer in oxidizing than smaller quantities, owing to the greater amount of heat?—A. No, I do not think they would.

11. Q. Do you think that would be in proportion to the surface presented?—A. Yes; I do not see any difference in that respect between a large and a small piece.

William W. Bradley.

6. Q. Did you have opportunities of observing the manufacture of guns?—A. I did, perfectly; I took a great interest in it, and saw everything.

7. Q. What was your opinion of the value of that system for making strong guns?—A. I think it was a most admirable system—the best I ever saw; that, if iron cannot be put together by that system, there is none by which it can.

8. Q. The whole question is whether welds could be made perfectly by that system. Do you think they could?—A. Yes; I think the plan of presenting the convex surface is the true one, and that thus all the scoria is forced out by the horizontal hammer.

All the evidence that is given before this commission in relation to Mr. Ames's pro-

cess of welding goes to prove beyond doubt only what was long before known, that wrought iron, if properly handled, will make a gun of more than double the power of endurance of cast iron.

But, unfortunately, Mr. Ames's plan of welding has nearly all the elements of failure. He can never be positively sure that one of several conditions may not intervene, and prevent a sound, perfect weld all over the surfaces. That he makes a better weld by his process only proves that he uses better material, and experienced, faithful forgers.

His manner of heating the fagot and handling it is very primitive. There are three elements here, either of which is fatal to a perfect weld, namely, underheating or overheating, oxidizing when removed from the furnace, and time, these dangerous elements being duplicated with two pieces thus handled.

Re-heating is also unavoidable and a dangerous element, so far as tensile strength is concerned.

How to get rid of all these perplexing elements occupied my mind more or less for fifteen or twenty years, when a little thought in the right direction overcame a multitude of difficulties; the result is this very simple mechanical forge, which enables me to handle tons of iron with less physical labor than Rev. Dr. Collyer expends in forging his horseshoes.

I have conquered all the above-enumerated dangerous elements. I never re-heat, never overheat, nor underheat; never have one piece too hot, the other too cold, the temperature being regulated in either furnace by the turn of the hand, wherein an even temperature may be maintained for hours if necessary. I avoid oxidizing, because the welding-surfaces are not exposed to the atmosphere.

Lastly, time is not taken into account in my case, for I can literally take my own time, and put the two surfaces together when the conditions are exact. And it makes no difference under such circumstances whether the area is one foot or twenty feet to be welded.

I have omitted all reference to experiments in foreign countries in regard to the many different fabrications of heavy ordnance, for the only thing that has been proved is that such guns must be made of iron or steel, or both combined. Self-reliance is a fundamental principle of success, and surely we have the material and talent to work on, and it only wants capital to unite them, when we can produce the best and cheapest guns in the world.

As for the time that it will take to forge a gun with my mechanical forge I cannot speak very positive, but any practical forger would not probably differ much from my estimate when he understands the system.

The contrast is so great, however, between my mode and all previous modes of forging, I am aware that I run some risk of being considered visionary.

The celebrated Horsfall gun, which took forty men seven weeks to forge, weighed about twenty-six and a half tons, and burned up about twenty-three and a half tons of iron in its fabrication; nearly 50 per cent.

One of the largest forgers of heavy shafting tells me that it is not unusual for them to burn up 50 per cent. of iron, but they base their estimates generally upon 33 per cent. Suppose a gun to be sixteen feet in length, average thickness of rings eight inches, then twenty-three welding heats are required.

All the machinery being perfect, and the workmen well drilled, would it be extravagant to say that a heat might be taken off every two hours?

Here we have forty-six hours instead of seven weeks, and probably 5 per cent. will cover the loss of material instead of 33 to 50 per cent., as at present.

The labor is another item worth considering, for I cannot conceive when more than eight or ten men could be wanted around this forge; perhaps half the number might answer.

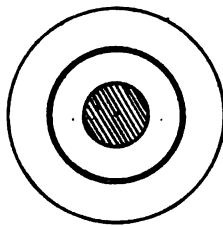
In conclusion, I will only say that, if a mechanical proposition can be proved without actually performing the operation, this matter of forging large masses of iron or steel without injury to the material would seem to be satisfactorily proved.

First. It will be conceded that iron and steel can *perfectly* be welded under favorable circumstances, the condition being perfectly simple, namely, a uniform temperature over the entire surfaces to be united.

Second. That those surfaces are to be brought into contact when in this perfect state without the intervention of any foreign substance or gas to produce any mechanical or chemical change or interference at the instant of contact. This is done by bringing the two surfaces together in the same atmosphere that has produced the welding heat. These conditions are fulfilled daily, and the theory and practice positively proved in the welding of Sir William Armstrong's coil-sections.

Third. The peculiar construction of my furnace enables me to present only the surfaces to be welded to the heat in the furnace, so that, while the surface of one of my rings may be brought to a welding heat, the underside of the same ring, say 8 inches thick, would not be brought up to more than what is technically called a "black heat," and it is not improbable that it could be done with one much thinner. This will depend mainly on the temperature of the furnace-heat, and mere matters of detail,

Plan of ring.



*Transverse section of rings.
Cross sections 8 in. square.*

Alonzo Hitchcock.

so that practically, I expect to improve the quality of the metals that go through my forge.

It is a very easy matter to substitute a hydraulic press in the place of my hammer in combination with the furnace, and I am of the opinion that the true way to forge, *i. e.*, to "upset" and weld the Armstrong coil, is by building the furnace high enough to receive the coil standing perpendicular, which may be six feet long, more or less. The press may work from the bottom or from the top as may be required, and this is what I propose to do in forging hollow shafting, for it appears to me that this coil is peculiarly adapted to the fabrication of shafting.

ALONZO HITCHCOCK,
408 West Fifty-fifth Street, New York.

In the specification of one of my patents in 1862 will be found the following sentence:

"One of the sides of the rings should be slightly dished or convex, so that when its convex side is placed on the flat end of the pile, the scoria and oxide are squeezed to the exterior with the flux by the action of the hammer, and the welding of the fagot or pile is commenced at its interior and continued toward the periphery."

L. B. No. 49.]

ARMY BUILDING, NEW YORK, August 12, 1872.

SIR: You are requested by the board on heavy cannon to furnish as soon as practicable estimates of the probable cost of the plant for your method of constructing a 12-inch rifle, also of the cost of the gun itself, accompanied by such further information regarding the details of your method as you may be able to furnish.

By order of the board.

Very respectfully, sir,

C. E. DUTTON,
First Lieutenant, Ordnance Recorder.

ALONZO HITCHCOCK, Esq.

No. 97.]

NEW YORK, August 19, 1872.

GENTLEMEN: In regard to the cost of the plant for my forge, I can only give an approximate estimate.

Taking Messrs. Sellers's estimate for the hammer, \$10,440, as a basis to start from, I make the following random statements:

In absence of working-drawings, and not knowing the price of the materials that are to enter into the construction of the gun, my estimates must be very imperfect, but in the aggregate I hope to cover the cost as far as the estimates go.

Commencing with the cylinder of the hydraulic press, I propose now to make the internal diameter 19 inches; walls, say, 6 inches thick, and, for the first one, 12 feet long, weighing about 8 tons. This casting, at \$160 per ton, \$1,280. This cylinder is to be re-enforced or hooped at the top and fitted up with a stuffing-box.

The plunger or ram will be made also of cast-iron, 18 inches in diameter when turned up, with an internal core 6 inches and 14 feet long, with the head fitted up to receive the anvil-block. This plunger will weigh about five tons; at \$160 per ton, (fittings, \$250,) \$1,050.

The anvil-block proper will consist of a large solid casting, say 4 feet diameter and 30 inches thick, with four arms radiating from its circumference to engage with permanent upright guides, and should weigh about 8 tons; at \$125 per ton, \$1,000; 4 guides and fitting for anvil-block, \$1,500; total, \$2,500.

Over the top of the anvil-block will be placed several loose blocks, about 2 feet diameter and 1 foot thick, faced up in a lathe. The castings of these blocks will weigh about 8,000 pounds; at 6 cents per pound, \$480; facing up, \$300; total, \$780.

These blocks are made to compensate for the shortness of the cylinder. A part of these would have to be taken off in forging a gun.

The more weight of iron put into these blocks and anvil-block, the better, as they absorb the momentum of the hammer and relieve the cylinder of strain.

The force-pump to operate this press need not be very heavy or expensive; for all practical purposes it may be worked by hand. It may be estimated at \$1,000.

Probably reverberatory furnaces will have to be used, and will have to rest on a floor supported on wrought-iron beams, passing through, as it were, between the legs of the hammer, the ends of the beams to rest on piers or cast-iron columns exterior and independent of the foundation of the hammer; otherwise the vibrations of the hammer might injure the furnace.

I estimate that \$5,000 will put up this furnace in the most perfect working-order including the cranes and accompanying gearing and tackle—

Making, in all.....	\$22, 120
Extras	2, 880
Total	<u>25, 000</u>

This estimate does not include the cost of foundations or stack.

The rings of which this gun is composed can be made of wrought iron or of low-welding steel. Of course steel is far preferable, and I have lately been informed by the agent of the Bolton Works, England, that they can make the rings as I want them of perfect homogeneous welding steel, that will stand a tensile strain of 75,000 pounds per inch, at 10 cents per pound, gold.

I shall immediately communicate with them, and, if this proves true, it will not be necessary to find parties to make them of wrought iron. I have no doubt it can be done in our own country, but it will take some time to find the parties, and then would probably have to wait for them to put up a tire-rolling machine.

I have agreed with some practical iron-men as to the mode of manufacturing the rings of wrought iron, if necessary.

Below you will see that I propose to make the rings in two parts circumferentially. This is reducing the difficulty they complain of in making so large a ring as one 40 inches in diameter.

It will be seen that this form enables the manufacturer to use a tire-rolling machine in connection with the hammer, by which means they can make as good a forging as can be made of wrought iron. In any event, they would probably cost as much as 10 cents per pound.

All of which is respectfully submitted.

ALONZO HITCHCOCK,

408 West Fifty-fifth street, New York.

The Honorable BOARD ON HEAVY ORDNANCE.

WILLIAM WHEELER HUBBELL.

H. O. No. 3, K.]

PHILADELPHIA, September 11, 1871.

SIR: I have the honor to inform you that letters-patent of the United States were, on February 8, 1870, granted to me for the invention of a process by which ordnance of any caliber, even to 15 inches, can be cast direct from the smelting furnaces using pig-iron, and the gun, when cast, be pure *cast steel all through*, possessing enormous strength, endurance, and projectile effect, far surpassing anything of cast iron now in the service.

Very respectfully, your obedient servant,

WM. WHEELER HUBBELL,

*Also Inventor and Patentee of the United States Navy Columbiad
and Percussion Fuses and of Shells.*

HON. WILLIAM W. BELKNAP,
Secretary of War.

[Inclosure.]

No. 5.] *Three Specifications of heavy rifled ordnance by William Wheeler Hubbell.*

PLAN A.

This piece of ordnance is for muzzle-loading, but capable of alteration into a breech-loader on my plan C, herewith submitted.

This gun is of combined steel and bronze, upon a plan or principle patented by me the 13th of September, A. D. 1864, for seventeen years. It consists of bronze cast around a steel tube or bore and breech, forming a solid steel facing within, and a firm body of bronze cast and cooled upon the steel without, forming a solid, compact mass by the union effected by the fusion of the bronze upon the steel tube. Secondly, a steel band may be shrunk upon the outer surface of the bronze at the breech alone, and extending as far forward as to the trunnions.

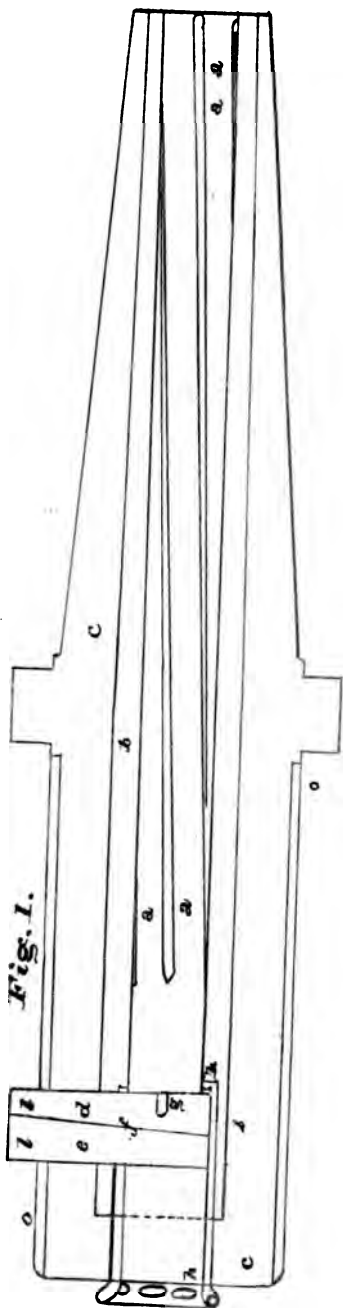


Fig. 1.

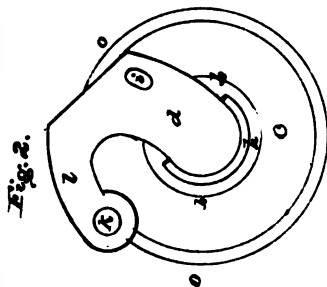


Fig. 2.

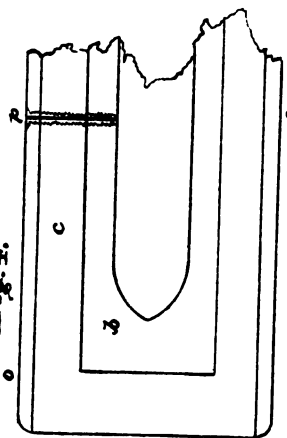


Fig. 3.

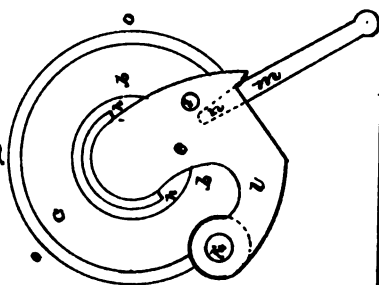


Fig. 4.

W. W. Hubbell.

I propose a gun upon this principle as follows: A rifled cannon, to be 12 inches in diameter in the bore-measuring across from base to base of the two opposite grooves; the grooves to be wide and four in number, of equal dimensions; the lands to be narrow and four in number, of equal size, each land to be $2\frac{1}{4}$ inches wide at the base, with sides radiating toward the center of the bore, each land to be four-tenths of an inch in height; one land to be located at the bottom at the muzzle, one at the top, and one at each side, to take a quarter turn in the length, and thus present the same relation at the breech in front of the powder-charge. The projectile is supported in the center of the bore by this construction and arrangement and number of the lands, and is readily loaded and constructed of a proper configuration and upon correct principles in consequence thereof, to be described.

The length of the bore is equal to fourteen diameters of the bore; the chamber or breech seems elliptical in form. The thickness of the steel bore from the breech-base to the trunnions is 4 inches, and from the trunnions to the muzzle it tapers to 3 inches thick at the muzzle. The outer surface of the steel bore has a screw-thread coarsely cut on it for the bronze to cast and close upon and hold it secure in every portion of its length. The steel is left 5 inches thick at the base of the chamber and the rear outer face at right angles to the barrel, that is flat. The thickness of the bronze around the 3 inches of steel at the muzzle is 2 inches, making, in all, 5 inches thick across the face of the muzzle, measuring from the base of the groove. The barrel tapers gradually thicker to the trunnions; each trunnion is 12 inches in diameter and 6 inches face from the shoulder. From the trunnions to the rear or breech the gun is cylindrical, 9 inches thickness of bronze and a $2\frac{1}{2}$ inch thick steel band shrunk upon it, making in all 15 inches of metal at the breech, being 4 inches of steel-bore, 9 inches of bronze, and 2 inches of steel band. I am aware that this outer 2 inches may be cast of the solid bronze instead of steel banding, and make a good gun, but I prefer the band of steel. Nine inches thickness of bronze is cast back of the steel breech-facing, to give great inertia and strength to resist the propulsive power of the charge.

I propose to place the touch-hole of this gun near the front of the charge of powder, so as to compel the perfect combustion of all the powder. The touch-hole is formed through a steel bush screwed in through the steel, bronze, and steel.

I propose to make the steel bore or tube of small strips of steel, each about an eighth of an inch thick and 2 inches wide, reverse lapped helically and welded over a properly constructed welding-furnace.

I purpose avoiding the use of thick pieces of metal to either bend or weld, as the *bending* of them under any circumstances ruptures the fibers of the metal on the outer circuits and renders their tensile strength unfit for the bursting strain of large guns.

The cost of this gun will be \$90,000.

WM. WHEELER HUBBELL.

I now propose a plan for another of the three guns, which I call

PLAN B.

This gun is in all respects the same as the plan A, with this modification:

I propose to take strips of steel one-tenth of an inch thick and 1 inch wide, and omitting the coarse screw-thread on the steel bore between the trunnions and breech, leave on it the last rough cut of the tool, and to lap this breech-portion with this flat thin steel helically, and reverse-lapped, leaving an inch space between the edges of the strips; and thus wrapping it for the 9 inches of thickness I cast the bronze into it solidly upon the tube, to test the question whether thin strips of steel thus applied to avoid the rupture of their outer fiber in bending them by being thin will really add any strength of importance to the gun, and whether the bronze will with entire certainty penetrate the interstices between the steel.

The cost of this gun will also be \$90,000.

WM. WHEELER HUBBELL.

For the third gun I propose a breech-loader as improved upon a principle I invented in 1841. This present improved gun I will call

PLAN C.

This is a breech-loading gun, and the construction of the barrel is similar to plan A altered to a breech-loader. This is accomplished by boring entirely through the breech to receive the projectile and charge in at the rear end.

The charge is inclosed in a flanged casing of steel or copper, which forms a gas-check; a central hole in the rear is covered with paper and a lead patch, which is pulled off when loading. The ordinary friction-primer fires it through a touch-hole in the

steel breech-gate. It is not deemed by me sufficiently safe to have such large cartridge-cases ready primed.

The charge is secured by a gate on a side-shaft, with bent arm, which allows it to fall inward and outward past the vertical line of gravitation, operated easily by one man. The gate is double, with wedge-surfaces between the two parts, allowing it to tighten up in the act of closing and loosen in opening. The rear half of the gate controls the front half by a pin working in a slot. The forward half falls in place, and the rear tightens up on it in inclosing the charge, and the rear half loosens with its wedge-surface by its pin in a slot, draws up the forward half, and opens the breech to receive the charge.

The shaft and bent arm are on the side, close to the gun, and the shaft is secured to a block secured to the rear part of the side of the gun. The breech is opened and closed by a handle, and also has a cog and teeth, with which it may be opened and closed. A hand extractor slides in and out to receive and extract the case from the rear end.

This gun also will cost \$90,000.

A plan of this gun is annexed, represented by Figs. 1, 2, 3.

The plans of guns A and B are the same as Fig. 1, excepting that they have solid breeches for muzzle-loading, and the Fig. 4 represents this solid breech, so formed, also, that it can readily be altered into the breech-loading system of Figs. 1, 2, 3.

In the accompanying drawings *a* are the lands, *b* the steel bore, *c* the bronze body, *d* the front half of the gate, *e* the rear half of the gate, *f* their bevel-faces, *g* the touch-hole, *h* the extractor, *i* the slot in the front half of the gate, *j* the pin operating in this slot and secured in the rear half of the gate, *k* is the gate-shaft, *l* are the bent arms of the gates, *m* is the arm to open them, set in *n* its socket in the rear-half, *o* is the outer steel band, *p* the touch-hole in the solid breech or muzzle loading gun.

WM. WHEELER HUBBELL,

No. 1607 Summer street, Philadelphia, Pennsylvania.

No. 27.]

1607 SUMMER STREET, Philadelphia, July 13, 1872.

SIR: Since my return I have received from Washington a copy of my patent for gun on the principle of those I propose, particularly plan A.

The plans B and C have additions: B, the steel ribbons; C, the gated breech-loading arrangement. I inclose this copy of patent, also one of Woodbridge's, that you may see their relative dates, and that the latter now abandons his bronze-faced or cast-iron faced gun, and simply proposes to use steel wire in the bronze of my steel-bored bronze-bodied gun.

In plan B I propose simply to place steel ribbons where the bursting strain comes, using a screw-thread on the steel bore both behind and before the steel ribbons, the same as my plan A or C, which have the screw-thread the entire length of the steel bore.

My patent controls the use of the steel bore and cast bronze body by grant of the United States, and I exhibited the plans to the Military and Appropriation Committees of the House, and got the appropriation increased to a sum sufficient to test them.

In referring to my records, I can now answer more definitely—

1. That the use of four grooves and four lands on a rifle-projectile, and with a small expanding base band, is contained in my patent of January 7, 1862, of which the United States now has the control, as provided by a joint resolution of Congress of June 3, 1864.

2. That the steel ribbons in plan B, being crossed about 1 inch apart, will allow the bronze to pass in toward the steel bore and fill the interstices, provided no pieces of the sand of the mold become detached and lodge to form sand-holes; and I think I can arrange the mold to avoid this in plan B. There is no possibility of such a casualty in plans A and C; they must cast clean and solid and float upward all sand or refuse matter.

My opinion or view is also that the breech-loading plan C can use either loose or serge-bag powder, or cased in steel.

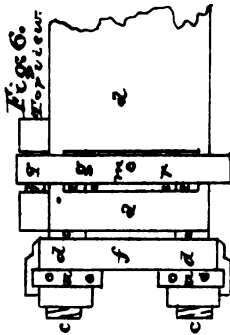
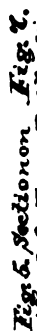
The steel can be used several hundred times, the same as now in small guns.

It will use loose or bag cartridges, because it tightens up; but that is a good property for an emergency only. I prefer to have steel cases ready for regular service and rapid firing, which latter is important as against steam iron-clads.

An equivalent method of tightening up the breech-gate, not so good, however, I think, is with a screw patented by me in 1860. I inclose lithograph of it, marked plan D. I do not propose to use this screw, though it could be applied to plan C, but I prefer the wedge-breech, as in C, for so large a gun, because it is more quickly operated, and the lever gives greater power to open it, and it is smaller and more compact, and the strain of the breech in C comes upon the solid metal, and not on a screw-thread.

The patent-plan E is a faucet-breech, good for small guns. It uses only bag-car-

Hubbell's Rifled Cannon.





N^o 44,194

W. W. Hubbell.

Fig. 1.

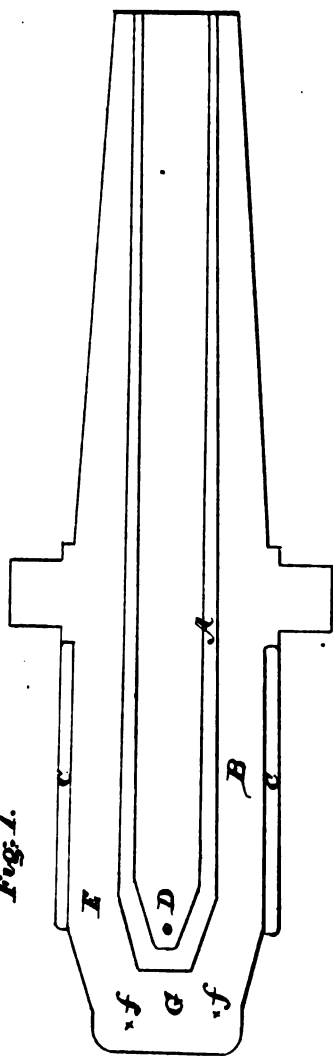
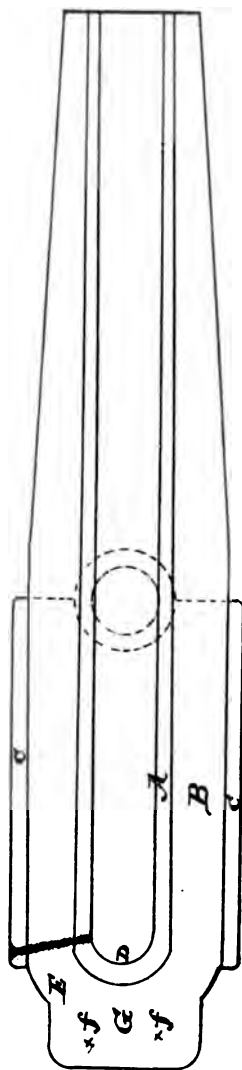


Fig. 2.



tridges; cannot use metallic cases. A 12-inch gun rifled could be made on this plan, but it would require sponging out each shot.

The plan C needs no sponging out with cased ammunition. It can use full-cased or half-cased with serge-bag projecting, or can in any emergency use common ammunition; is under perfect control in every way. As to power to load and extract the case, I can attach a lever at any instant to the extractor to start the case out with 2,000 pounds power if needed. Have done it with a lever in a small gun. As you have to examine, I present them, but adhere to plans A, B, and C, as presented. All the minor details are under perfect control in those guns.

Respectfully,

WM. WHEELER HUBBELL.

PRESIDENT OF BOARD OF ORDNANCE OFFICERS

On 12-inch Rifled Ordnance, New York.

[Enclosure.]

[Hubbell's patent 13th September, 1864, for steel-bore and breech, with a bronze body cast upon it. Plan A, B and C, with additions.]

William Wheeler Hubbell's improvement in the construction of ordnance. Patent No. 44194, dated September 13, 1864.

Be it known that I, William Wheeler Hubbell, of the city of Philadelphia and State of Pennsylvania, attorney at law and scientific engineer, have invented a new and useful improvement in ordnance; and I hereby declare the following to be a full, clear, and exact description thereof, reference being had to the annexed drawings making part hereof, in which—

Fig. 1 is a section of the improved gun and Fig. 2 is a section of the gun with another form, chamber, and breech.

The nature of my invention consists in constructing large cannon of such material, form, and proportions as to combine all the advantages of wrought iron or steel without its disadvantages, with all the advantages of bronze without its disadvantages.

Wrought iron or steel are superior to form the facing of the breech and bore, because they withstand the effects of the fire better than other metal, but they can only be constructed with certainty and extreme strength of a thickness of about 4 inches; and when thicker, or of large body of an entire large gun, the iron or steel is not only but poorly welded, but granulates rapidly by the vibrations of discharge and is very liable to burst. On the other hand, bronze or gun metal, consisting of about nine parts of copper and one part of tin, or the base of which is copper, makes a strong gun, but it absorbs heat too rapidly for a large gun; and the intense action of the fire on a bronze bore soon disintegrates or destroys it by separating the tin and changing its size and form. It, however, has the advantage over iron or steel in malleability, non-liability to granulate or weaken by firing; its vibrations are not intense.

My invention retains all the advantage of the iron or steel and all the advantage of the bronze, by which I am enabled to make cannon of 12 and 15 inches in the caliber, and capable of enduring from 60 to 100 pounds of powder for a charge, and of driving a shot with unparalleled velocity and consequent destructive effect to crush iron-clad vessels or forts.

I make a solid breech D and barrel A in one piece of wrought-iron, about 3 or 4 inches thick of metal at the breech, and tapering slightly outside smaller toward the muzzle. This breech and barrel is welded in any of the well-known methods of forming and welding gun-barrels. It should be made of bars and coils welded by pressure, and when turned uniform around it is suspended vertically in a mold, in a heated state, and the bronze breech E and barrel B in a solid body, so that there are no joints for the vibrations or strain to settle upon; but the entire strength of both metals is obtained.

Around the bronze, when turned off, I shrink a single sleeve of wrought iron or steel, C, which clasps the bronze between its inner surface and the outer surface of the breech and barrel behind the trunnions in one grip, without any joint for vibrations and strains to settle upon.

The bronze, being a malleable metal, takes up the vibrations and protects the outer band from their effects, while the outer band prevents the expansion of the bronze and the inner iron or steel protects the bronze from excessive fire and disintegration. Thus these metals aid each other, and the extreme strength of iron or steel and bronze are obtained and applied in this gun without any of their disadvantages. The cascable, G, should or may be large and cylindrical and curved off from the centers, *ff*, to afford strength and base of resistance to the action of the charges on the base of the breech-chamber.

There are certain proportions or limits of these metals within which these maximum principles and results are most advantageously obtained, namely:

For a field-gun 3 inches in the diameter of the bore, or 4 inches in diameter of the bore

the wrought iron or steel of the bore should be 1 inch thick at the muzzle and $1\frac{1}{4}$ inches thick at the breech as far forward as the trunnions, and taper gradually from the trunnions to the muzzle. For a fortification or a naval gun of 6 inches or of 8 inches diameter in the bore, the thickness of the wrought iron or steel of the bore at the muzzle should be 2 inches, and the thickness at the breech, as far forward as the trunnions, should be 3 inches, and taper gradually toward the muzzle.

For a 10-inch or a 12-inch gun the thickness of the wrought iron or steel of the bore at the muzzle should be $2\frac{1}{2}$ inches and the thickness at the breech be $3\frac{1}{2}$ inches.

For a 15-inch gun the thickness of the iron or steel of the bore at the muzzle should be $2\frac{1}{2}$ inches, and the thickness at the breech be $3\frac{1}{2}$ inches.

For a 20-inch gun the iron of the bore may be increased to 6 inches thick at the breech and remain $2\frac{1}{2}$ inches thick at the muzzle.

The taper may extend from the breech to the muzzle gradually.

The thickness of the bronze at the muzzle for field-gun should be equal to the thickness of the iron of the bore at the muzzle, and for large guns, for iron-clads, to protect it from being too easily shattered by shot, the thickness of the bronze at the muzzle may be about twice as thick as the thickness of the iron or steel of the bore at the muzzle.

To give requisite strength at the breech to withstand very heavy charges, the thickness of the bronze over and above or in addition to the thickness of iron or steel of the bore should be sufficient to make up a thickness equal to the measurement or diameter of the bore exclusive of the outer band of iron or steel, and the outer band should be equal in thickness to the thickness of the inner iron of the bore. Thus a 15-inch gun would have $3\frac{1}{2}$ inches of thickness of iron bore, $11\frac{1}{4}$ inches of bronze, and $3\frac{1}{2}$ inches of an iron band, making $18\frac{1}{4}$ inches of metal thickness at the breech, to stand about 80 pounds of powder for a charge, with a shot of about 450 pounds weight. In making a rifled gun, say, of 12 inches in the bore, to use about 80 pounds of powder, with about a 500-pound elongated shot, the same, or 18 inches thickness of the metals, should be retained, because it must always be observed that the strain on the gun is mainly due to two causes, namely, the quantity of powder used and the weight or resistance of the projectile, and it is increased by increasing the elevation of the gun and increasing the quickness of the powder. As a general rule, taking the sizes of guns mentioned for spherical shot, the rifle-gun to throw the same weight of shot of elongated form, with the same high charges and much greater range, should, although less in diameter of the bore, have the same thickness of metals at the breech as would be used for a smooth-bored gun using spherical shot of the same weight. A general rule as to the length of the gun should be a length of bore equal to fifteen times its diameter, taking the smooth-bore as the standard, and not reducing the length of the rifle-gun, although its bore is reduced in diameter, to throw a projectile elongated and of the same weight as the spherical shot for the smooth-bored gun of similar length. The proper extreme limits of the thickness of the inner iron or steel of the bore are not less than 1 inch and not over 6 inches, the thickness being greatest, as stated, with larger sizes of guns.

For light field-guns the entire thickness at the breech should be equal to the diameter of the bore. The outer band need not extend forward entirely to the trunnions, except where very heavy charges are intended to be used, and in case of this iron band extending as far forward as the middle of the trunnions, as shown in the drawing, the trunnions themselves may be of iron welded on to or forged with the band.

I am aware that suggestions have been made to construct guns of cast iron, or bronze and iron, or steel and a flux, without definite form, discrimination, and proportions, kind or construction of gun, which I do not claim, leaving the matter in an experimental and undetermined condition, not reduced to this positive form, proportion, use of metals, or discriminated construction and invention of mine, which special metals, form, proportions and construction are necessary to develop the maximum advantages and my invention.

The trunnions may be cast of bronze with the gun or separately attached to it on Dahlgren's plan.

What I claim, therefore, as my invention is:

1st. Casting the bronze with solid breech and barrel, in a solid body, around the solid breech of wrought iron or steel, and the barrel united in one piece in the form and proportions set forth to combine the extreme strength and other advantages of both these metals, as described.

2d. Shrinking or securing the one wrought-iron or steel band upon the bronze breech surrounding the solid wrought iron or steel breech and barrel, so as to clasp the bronze between the wrought iron or steel of the band and the wrought iron or steel of the breech and bore, most solidly in combination from the breech to the trunnions, substantially in the manner and for the purpose described.

WM. WHEELER HUBBELL.

Fig. 1.

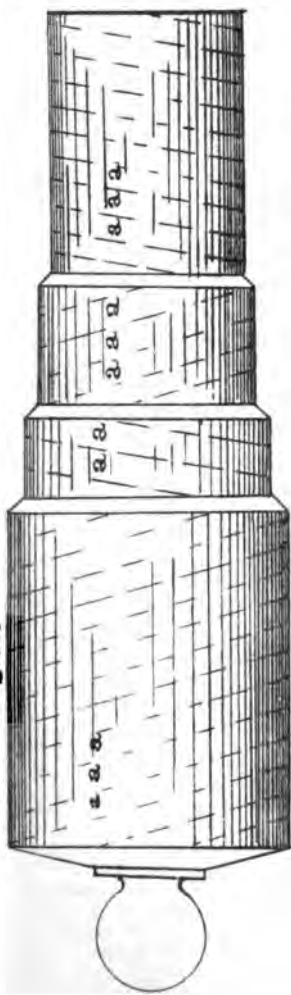


Fig. 3.

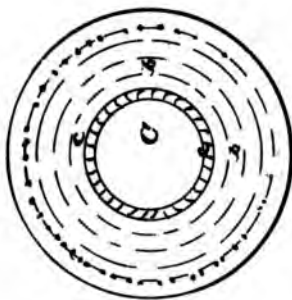
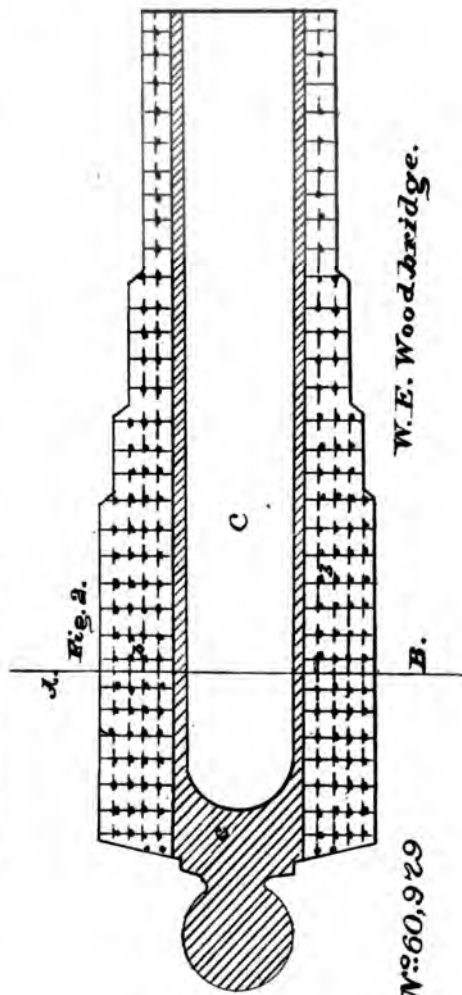


Fig. 2.



Nº 60,929

[Inclosure.]

W. E. Woodbridge's improvement in the construction of ordnance No. 60979. Patented January 1, 1867.

Be it known that I, W. E. Woodbridge, of the village of Little Falls, county of Herkimer and State of New York, have invented a new and useful improvement in the construction of cannon; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings. The nature of my invention consists in the disposition of helices of wire, constituting in general the principal part of the mass of the cannon, and their union by a more fusible metal employed as a solder, and also used, when desired, as the material forming the walls of the bore.

The helices herein referred to may most conveniently be formed by winding the wire in successive layers on a cylindrical mandrel or former, which should be enough larger than the intended bore of the gun to admit of finishing the bore, including the grooves, if it is intended for a rifle, entirely within the inner helix of wire, and without coming in contact with it, as it is better that the surface of the bore should be of uniform metal. The mass of wire thus wound must, of course, be proportionate to the size of the intended gun. In order to meet the combined strains to which a cannon is subjected, tending to rupture it both longitudinally and transversely, it is desirable that the wire should be wound in spiral of considerable obliquity (which may be effected by winding a number of wires placed side by side at the same time) and that the obliquity should be reversed in the alternate layers, the wires of each layer crossing those of the layer immediately under or over it. It will be perceived that in this way the tendency to unwind under the action of internal pressure in any particular layer will be counteracted by that contiguous to it. The proper degree of obliquity may be attained by winding such a number of wires at once as shall form a band about equal in width to the diameter of the bore. This rule is based upon the supposition that a metal equal in tenacity to bronze, or nearly so, is used as a roller; but when a less tenacious metal is employed the obliquity may be advantageously increased; in no case, however, need it exceed that produced by winding a band of wires once and a half in width the diameter of the bore. The arrangement of the wire above described and its position in relation to the finished gun are illustrated in the accompanying drawings.

Fig. 1 gives an external view of a gun composed of five helical layers of wires, (a smaller number will often be used in practice, but convenient for illustration,) and shows the course of the wires, indicated by the dotted lines *a a*, in four layers, whose surfaces are exposed in parts of the gun differing in diameter. The forward part of the gun, composed of two layers, presents but one at the surface, though both are shown in section in Figs. 2 and 3.

Fig. 2 presents a section of the gun on the axis of its figure.

Fig. 3, a cross-section on A B of Fig. 2.

The dotted lines *b b* show the lines of contact between the different layers. *C* is the bore of the gun, and *c c* the metal forming its walls within the innermost helix. In general the mass of wound wire is withdrawn from the mandrel or former before soldering, unless the latter be made of the metal to be used as a solder, in which case it may be unnecessary, as it will be melted in the process. The mandrel may, in other cases, be made of a material of which it is desired to form the walls of the bore, when it is evident it should be allowed to remain and become united to the wire. I also propose to use in place of wire, in some cases, especially when cast iron is to be used as a solder, rods of metal, iron, or steel, drawn out by rolling or hammering. The soldering of the iron may be effected by any known process, and with any metal or alloy suited to the purpose, the particular process and the subsequent finishing of the gun forming no part of my present claim. The use of cast iron as a solder is recommended by its cheapness, and it should be employed with wire of very large size, or with rods larger than are drawn into wire. This is rendered desirable by the action of cast iron on iron containing less carbon, to which it imparts, at the high temperature requisite for its employment as a solder, a portion of its own, changing to some extent the properties of both metals. The same action renders it desirable that the spaces for the passage of the melted metal into the interior of the mass to be soldered should be larger than when bronze is employed, and round wire is, therefore, more suitable than square, which leaves, when wound, much smaller spaces between its turns. It is recommended that when cast iron is used as a solder, the walls of the bore and the closure of that cavity at the breech of the gun should be constituted of the same metal, supplied for that purpose, within the inner helix of wire during the process of soldering, as represented in Figs. 2 and 3, at *c c*. This remark may also apply to the use of any metal as a solder which possesses the requisite qualities for forming the bore of the gun. When the mandrel upon which the wire is wound is retained to constitute the walls of the bore, a portion of the same may be allowed to remain in the formation of the breech, or the bore may be closed in any other way that may be preferred. In order to carry my invention into effect it is necessary that the fused metal employed

as a solder should unite with the wires or rods, and not merely surround them without adhering thereto. The materials which I esteem the best for the construction of guns, irrespective of cast, are steel wire of a quality usually called "low steel," drawn square, or nearly so, with a hard bronze as a solder; but I also propose, in some cases, to use wire wound under constant tension, and united with a solder of low fusibility, so that the elastic tension of the wire may not be disturbed in the process. I also propose to apply the mode of construction herein described to tubes other than cannon when the mechanical requirements are similar.

What I claim as my invention, and desire to secure by letters-patent, is—

1. The employment, in the structure of cannon, of helices of wire of reversed obliquity, applied one over another, and brought into union by the intervention of a more fusible metal employed as a solder.

2. I claim, in general terms, the construction of cannon substantially as herein described, modifying the selection and use of materials as herein set forth.

3. I also claim the application of the mode of construction herein described to tubes other than cannon, when the mechanical requirements are similar.

W. E. WOODBRIDGE.

NOTE BY MR. HUBBELL.—"Woodbridge's patent of January 1, 1867, consists of cast iron cast upon a cast-iron shaft, with wire around it, and bored out; or bronze cast upon a bronze shaft, with wire around it, and bored out. Has no steel bore, and not cast upon a steel tube. Over two years after Hubbell's patent in date."

Plan E.

W. W. Hubbell's improvement in breech-loading ordnance, No. 43412, patented July 5, 1864.

Be it known that I, William Wheeler Hubbell, of the city of Philadelphia, and State of Pennsylvania, have invented a new and useful improvement in breech-loading ordnance, and I hereby declare the following to be a full, clear, and exact description thereof, reference being had to the annexed drawings making part thereof, in which

Fig. 1 is a ground plan of the cannon.

Fig. 2 is a vertical longitudinal section through the axis of the cannon, with the faucet-breech open, and the projectile and charge in the chamber in front of it.

Fig. 3 is a vertical longitudinal section through the axis of the cannon, with the faucet-breech closed, securing the projectile and charge in the chamber of the gun, ready to be fired.

Fig. 4 is a view of the faucet-breech, exhibiting the opening through the upper half of its diameter to form the channel for loading the charge through, and the lower half of the faucet-breech is left solid to form a strong breech to the chamber of the charge.

Fig. 5 is a front view of the faucet-breech, exhibiting the copper adjustable facing to tighten the joint at the breech.

Fig. 6 is a view of the rear part of the gun.

Fig. 7 is a cross-section through the center of the breech, with the breech closed as shown in the Fig. 3.

Fig. 8 is a cross-section through the center of the breech, with the breech open as shown in Fig. 2.

The nature of my invention consists in the peculiar construction of the faucet-breech, the breech-cylinder, and its loading-hole, and their combination with the side plates, and other means presently described, to constitute a cannon, or gun supported by trunnions, for field, fortification, or ships use, of sufficiently light weight and strength combined, and to load with facility at the breech, and keep tight, with provision to prevent binding from the expansion by heat and from dirt.

I am aware that faucet-breeches, with a charging-hole, across through the axis of the breech, and about an equal portion of metal left on each side of it to form a breech for small-arms, have been made; but such a breech for cannon would be too weak, and would require the breech-cylinder to be elevated above the top of the barrel, both of which are objectionable. The line of sight should be along the top of the barrel, as in my improved cannon. Also, the screw and the cam-groove and pin applied to such faucet-breeches are inadequate to tighten and release the breech for a cannon, and clog up with dirt. Also, I am aware that Holensshade's gun, with the eccentric plates and charging-chamber contained within the faucet-breech, requires a heavier construction of breech than this present gun, and also shoots past a joint. And it is the object of my invention to construct the gun so as to diminish the size and weight, not shoot past a joint, and to have the gun sufficiently light, and strong, and otherwise service-

Nº 13,412

W. W. Hubbell's Improvement in Ordnance.

Fig. 1.

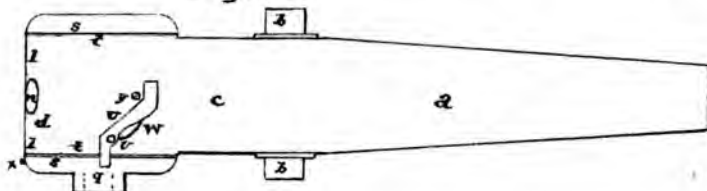


Fig. 2.

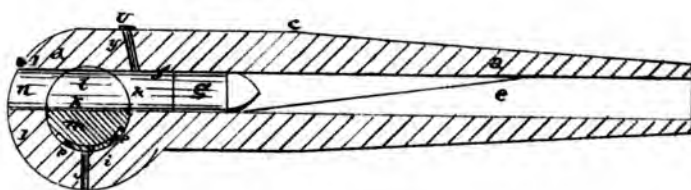


Fig. 3.

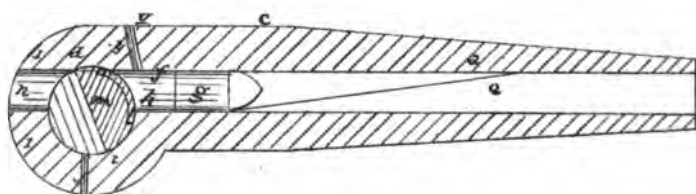


Fig. 4.

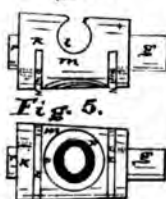


Fig. 6.

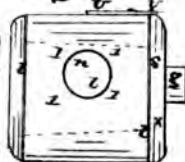


Fig. 7.

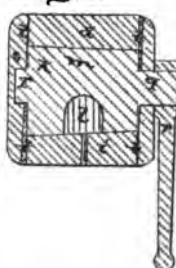


Fig. 8.

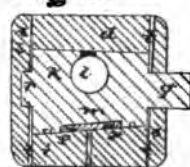
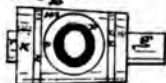


Fig. 5.



able, as herein described; to load at the breech, and use rifle or elongated projectiles, to compress immediately on starting into the rifle-grooves.

a is the barrel of the gun; *bb* are the trunnions to sustain it; *c* is the top of the barrel and line of sight; *d* is the breech-cylinder; *e* is the rifled or smooth bore; the diagonal line indicates that the rifle-grooves commence immediately in front of the projectile; in loading, it should be set against them; *f* is the chamber containing the projectile *g*, and the charge of powder *h*; *i* is the lower part of the breech-cylinder, which enlarges below the barrel *a*, to receive the faucet-breech *k*; *j* is a small hole to discharge water and dirt from the faucet-breech, through the bottom of the breech-cylinder *i*; *k* is the coned-faucet breech; *l*, the loading-hole through its upper half, leaving *m*, the remaining metal, in a body to form a breech to the chamber *f*; *n* is the loading-hole through the back part of the breech-cylinder, with the metal solid around it at 1, 1, 1, 1, (Fig. 6,) to receive the recoil strain; *o* is a curved copper plate let into the faucet-breech, with *pp*, its bearing-face, against the back facing of the chamber *f*. Inside of the facing is a groove shown in the drawing, so that the gas may form behind, press the bearing-face forward, and tighten the joint at *pp*, (Fig. 3); *q* is the shaft or projecting end of the coned faucet-breech, to which the handle *r* is attached to work the breech; *r* is the opposite end of the breech which keeps the plate *s* in position. The plates *ss* may be secured firmly to the ends of the faucet-breech; one of them may be cast in one piece to or with the breech at its largest end. These plates *ss* have helical plates attached to their inner faces around the faucet-breech, and working against counter-plates secured to the sides of the breech-cylinder at *t*, *t*, *t*, *t*, to release and tighten up the breech.

The breech is brought up with its face, *o*, from against the rear face of the chamber *f*. The copper face *o* may be dispensed with, and the breech-face left solid and plain to form the surface behind the charge. Also the copper face may be used plain, or without the groove cut in it, so as to prevent the faucet-face from being burned, and the copper when burned or worn can be renewed. The faucet-breech may be shortened, and the plate *ss* let in flush with the sides of the barrel to lighten the gun. The barrel of the gun may be made of bronze cast around a wrought-iron or steel bore, or all of iron or steel, or all bronze, and the faucet-breech may be cast of bronze, and cored to lighten it; or it may be made of iron or steel. I do not limit myself to any particular metals to make the gun; and a wrought-iron band may be shrunk on a cast-iron barrel forward of the breech-cylinder, and the trunnions be afterward attached. *u* is a lever to close the vent *y*, when the breech is open, as in Fig. 2, and to open it when the breech is closed, as in Fig. 3, to prevent the gun from being fired when the breech is not fully closed; *w* is a spring to force the lever over the vent; *v* is a pin turning with the breech to force the lever off of, and uncover the vent *y*, when the breech is closed, as in Fig. 1; *x* is another pin, on the plate *s*, to force the lever over the vent *y*, in case the spring *w* is broken, when the breech is open for loading, as in Fig. 2. *z z* are grooves, one each side of the breech-facing *o*, to secrete any dirt, and a small hole extends from their base at right angles, out at the ends, to let the dirt escape. The breech-cylinder may be provided with a spring, and a catch on the plate *s*, next to the handle *r*, to secure the breech when closed, and another catch or beveled face and shoulder to secure the breech when open. When the breech is open, as in Fig. 2, the projectile is inserted point foremost into the loading-hole *n*, through and past the channel *l* of the breech, into the chamber *f* of the barrel, against the rifle-grooves and lands; and the charge of powder *h* is passed in afterwards, contained in a serge bag; or the charge *h* and projectile *g* may be connected and inserted together, and the handle *r* is turned down, which moves and presents the metal *m* of the breech next to the charge, inclosing it tightly, the helical plates releasing and tightening up the breech in turning it, and the lever *u* closes, and opens the vent *y*, to receive the primer to fire when the breech is closed.

Another mode of securing the plates *ss* and the eccentric faces is to secure the plates *ss* firmly to the sides of the breech of the barrel, having the eccentric faces formed on their inner sides around the shaft of the faucet-breech, and extending radially from it equal to the diameter of the faucet-breech; and the counter-eccentric faces are then formed on the ends of the faucet-breech, extending radially from its shaft, one of them on each end of it, to tighten up and loosen this coned faucet-breech-piece in loading and firing. The side plates and metal of the breech behind the charge may be reduced, in diameter and thickness, below the thickness of the gun around the charge, and thus still further lighten this peculiar construction of gun for light-artillery and boat service. The great advantage of this gun is its peculiar and simple construction, adapted to the use of elongated projectiles within iron-clad vessels and in fortifications, whereby the gunners at the breech can be protected by a shield from sharpshooters. When the plates *ss* are fixed firm, as last above described, then the pins *v* and *x*, to operate the lever *u*, are secured to the shaft of the faucet-breech outside of and close to the plate on either side.

1st. What I claim is, the peculiar combination of the loading-hole *n*, through the breech-cylinder, with the metal solid around it, with the channel *l*, through the upper

side of the coned faucet-breech, and the chamber *f* in the barrel, for the purpose of forming a strong, light, and serviceable construction of breech-loading cannon, as described.

2d. Also, I claim the automatic vent-stopper or finger *u*, operated by the spring *w* and pin *v*, as described.

3d. Also, I claim enlarging the breech-cylinder beyond the barrel, on the lower side of the barrel, and leaving the straight line of sight on the upper part, with the loading-hole *z* through the metal, to adapt it to the faucet-breech for cannon, as described.

WILLIAM WHEELER HUBBELL.

A. W. KERCHEVAL.

L. B. No. 23.]

ARMY BUILDING, NEW YORK,
July 17, 1872.

SIR: Your letters to the Adjutant-General of February 2, February 21, and July 5, have been referred to the board on heavy cannon, now in session in this city, and I am directed to inform you that your proposition does not come within the purview of this board, which was convened for the purpose of deliberating upon heavy rifled guns.

Very respectfully, sir,

C. E. DUTTON,
First Lieutenant Ordnance, Recorder.

A. W. KERCHEVAL,
Romney, West Virginia.

FRIED. KRUPP.

No. 18.] [Fried. Krupp à Essen (Prusse,) Gusstahl-Fabrik. American office, 15 Gold street. P. O. Box 2878.]

NEW YORK, July 5, 1872.

SIR: In answer to your inquiry for specification of 12-inch Krupp steel breech-loading gun, we submit the following:

Gun:

Caliber, 12 inches.
Length over all, 22 feet.
Weight, 36 tons.

Projectiles.	Weight.	Charge of gun.
Steel shell.....	647 pounds.	115 pounds.
Chilled-iron shell.....	670 pounds.	151 pounds.
Common shell.....	568 pounds.	100 pounds.

Wrought-iron carriage:

Height of firing, 7 feet 8 inches.
Weight, 21 tons.

We also respectfully present for the use of your board:*

1. Collection of photographs of guns, projectiles, &c.
2. Critical comparison: Doppelmair.
3. Comparison of Krupp's breech-loaders with Armstrong's muzzle-loaders.
4. Gunnery experiments.
5. Results of target-firing.
6. Field-artillery: Michaelis.
7. Army and Navy Journal, September 9, 1871, and June 29, 1872.
8. Various circulars.

The Army and Navy Journal, September 9, 1871, page 51, contains an article describing the method of manufacturing the Krupp guns.

For further information on the subject, we respectfully refer you to No. 21, Professional Papers Corps of Engineers, pages 84 and 111, "Report on fabrication of iron for defensive purposes," by Generals Barnard and Wright, United States Army; also to

* These documents are too voluminous for publication. The article from the Army and Navy Journal of September 9, 1871, however, is here inserted, as being descriptive of the method of manufacturing the Krupp guns.

reports dated December, 1870, (and now on file in Ordnance Bureau, Navy Department,) of Captain E. Simpson and Lieutenant-Commander J. D. Marvin, United States Navy, who inspected the works at Essen, under instructions from the Secretary of the Navy.

We remain yours, respectfully,

THOS. PROSSER & SON.
A. MOORE.

Major SILAS CRISPIN, U. S. A.

[Indorsement.]

UNITED STATES ORDNANCE AGENCY,
New York, July 10, 1872.

Respectfully referred, together with its inclosures, to the board on heavy ordnance, convened by General Order No. 57, dated June 28, 1872.

S. CRISPIN,
Brevet Colonel, U. S. A., Major of Ordnance.

[From the Army and Navy Journal, September 9, 1871.]

THE KRUPP GUN.

Steel-gun making in the perfection of its details is best seen at Essen, in Rhenish Prussia, in the monster works of Mr. Krupp, since here the manufacture may be followed from the refining of the crude ore up to the finishing stroke and proof of the completed gun; while at the London ordnance-works of Vavasseur only the processes of assembling, rifling, &c., can be studied, the various parts being roughly prepared in Sheffield, at the steel-works of Firth. Mr. Krupp's great establishment, originally designed for the production of rolling-stock, rails, crank-shafts, &c., has within the last decade been gradually so changed in its character as to now render it practicable to employ almost the entire force of mechanics in the fabrication of ordnance and artillery. An idea of the immense facilities here for turning out work may be formed from the following statistical statement:

The works cover an extent of about 700 acres, 300 of which are under roof, and employ 8,000 men; besides which, in the Krupp coal-mines near Essen, and in the iron-pits and blasting-furnaces on the Rhine, 2,000 men are constantly at work providing material for the use of the establishment, which possesses for the consumption and manufacture of the products of the mines 480 smelting, reverberatory, and cementing furnaces; 247 steam-engines, from 2 to 1,000 horse-power; 54 steam-hammers, from 1 to 50 tons weight; 169 forges, 331 lathes, 61 cutting and shaping machines, 93 grinding-machines, and furnaces to accommodate 1,600 crucibles, of 70 to 75 pounds capacity each.

With these appliances, ingots can be cast and worked from the size required for a file-blade up to that of 110,000 pounds weight, used in the 14-inch gun; thus representing a capacity three times that of the largest steel-works in England.

The metal used in the Krupp gun is crucible cast steel, made from a combination of puddled steel and pure wrought iron, which forms the charge of the crucible. The proportions of each, manner of preparation, &c., are not made known, as the secret by means of which Mr. Krupp produces a metal fully equal in elastic and absolute strength to the best of English cementation steel, and that, too, without oil-tempering, lies somewhere in the preparation of the elementary substances, or in the combination of them formed in the crucible. Only this is known: the wrought iron is produced from hematite ores, both English and German; the puddled steel from the spathic ore of Siegen; while the spiegeleisen, small quantities of which are used, is made from the long crystal variety of that ore found in Nassau. The ingots from which the various parts of the gun are formed are cast in cylindrical iron molds, the metal being introduced at the top. Every precaution possible is taken to insure homogeneity in the casting; for unless steel be absolutely sound in the ingot, no amount of hammering or pressing will make it so, as the bubble-holes caused by air or gas become sealed without being removed, and all subsequent treatment simply presses them out into long slits, more objectionable than the original defect, since it completely prevents welding. When sufficiently hard to permit handling, the ingot is removed from the mold and buried in ashes, where it slowly cools. When needed for use, it is brought to the required heat in an ordinary furnace, and drawn out to the proper length under a hammer, one of 50 tons weight being used for large ingots. After this the head containing the "piping" and all other defective metal is cut off, and the ingot thus drawn out again buried in ashes, where it gradually anneals, taking out all tension due to

forging into shape. Ingots thus drawn out are, by the various processes of boring, turning, and rifling, converted into the tubes forming the inner structure of the gun, while those intended for use as hoops, trunnion-bands, &c., are cut up into short lengths of the required weight and formed into rings without weld, the pieces being split down the center to a certain distance from either end, and swaged out under a heavy hammer to the desired shape, after which they are annealed and finished by lathe-work. The Krupp gun consists (Fig. 4) of a central tube, A, and of series of encircling hoops, B, C, &c., the 6-inch having one set, the 8 and 9 inch two, and the 11-inch and higher calibers, three. The tube, comprising the greater mass of the gun, is of cylindrical form, with walls eight-tenths of a caliber thick from a point over the middle of the charge to that at which the rings terminate; thence to the muzzle it is conical, diminishing to one-half caliber.

The hoops, shrunk on at a black heat, are prevented from working on the tube or inner layers by key-rings, A, A, (Fig. 4,) which are half hoops laid into scores cut to receive them.

The rifling is polygrooved, the two sides of each groove being of different pitch, by which means the width of the grooves is made to diminish as they approach the muzzle, or, what is the same thing, that of the bands increases, thus insuring complete suppression of windage as the soft-jacketed projectile passes along the bore. The chamber in which the shot and charger rest when the gun is loaded is of greater diameter than the bore, and its axis is eccentric to and above that of the rifled part. This is done to give desired working room and still retain the axis of the projectile as a prolongation of the axis of the bore, for by this the course of the shot, from the instant it is put in motion until it leaves the gun, is rectilinear, not being canted upward in passing from a tube of greater to one of less diameter, thus abrading its jacket, and at the same time allowing gas to escape by it, which occasions loss of power as well as scoring and damaging of the gun, an action which in a perfect breech-loader is entirely prevented by the gas-tight joint formed by the projectile when properly centered.

The most important detail in the construction of a breech-loading gun is an efficient and durable gas-check; and this has been successfully applied in large guns by Mr. Krupp alone. The rear of the chamber is reamed out spherically, and in this recess is fitted a Broadwell ring (Fig. 3) whose exterior is also a spherical segment, the advantage of that form being its ease of adjustment and the readiness with which it can be pushed into position by the breech-block should it become unseated. When the gun is discharged, the ring, being instantaneously expanded and at the same time pressed rearward with tremendous force, hermetically closes the tube of the piece and prevents all escape of gas. On its rear face are annular scores to take up residuum or oil from the face of the breech-block and thus avoid clogging. In the slot cut in the rear end of the tube to receive the mechanism, two guides, *b, b*, (Fig. 4,) are left in relief, and in the breech-block, grooves are formed to correspond. These stand at an inclination to the face of the slot formed by the breech of the gun, via the lines A B and C D, (Fig. 2,) so that a motion of translation in or out gives to the front face of the block, at the same time, a movement forward or to the rear parallel to itself. The rear of the slot in the tube is cut on the same inclination as the guides, so that the block, whose front top and bottom are plane surfaces, its rear rounded off, is, when screwed in, well supported from behind.

The motion of translation is given to the block by the screw E, Fig. 2, which runs partly in a thread cut in the upper wall of the slot. The locking is accomplished by the screw A, Fig. 1, working in a nut having rings on its exterior partially cut away, which take in the scores *g, g, g*, Fig. 2, cut in the solid mass at the rear of the slot. These screws are worked in turn by the lever-wrench R, Fig. 2. The vent is through the breech-block in a prolongation of the axis of the bore, terminating in the face-plate *f, f*, Fig. 2.

Both steel and chilled-iron projectiles are used in these guns for practice against armor. They are cylindro-ogival in form—with radius of head approximately two calibers. Those of steel are forged, bored out to receive the bursting-charge, and have their points water-tempered. They are then jacketed by a process of soldering. It is of great importance that the weight of lead should be reduced to a minimum, in order to avoid loss of momentum on the striking of the shot, due to the flying off of the lead at the first instant of impact. After long experiment a plan has been devised by means of which practically no power is lost. The projectile, having been turned smooth on its cylindrical part, is placed in a bath of sal ammoniac to remove all oil, after which it is immersed in molten zinc, thence in lead, and afterward put in a mold where lead is run around it. It is then taken to a lathe, where the lead is turned down to a very thin coating, rings three to five in number, according to the caliber, being left on it, the rings being 0.1 inch and the spaces 0.05 inch thick.

The powder used in all the large guns is the prismatic, first suggested by General Rodman. Each grain is a hexagonal prism, 1 inch high, faces 0.8 inch wide, with six cylindrical perforations 0.15 inch in diameter running through it in the direction of its length. These prisms, of a density 1.70, average 12½ to the pound.

Fig. 1.

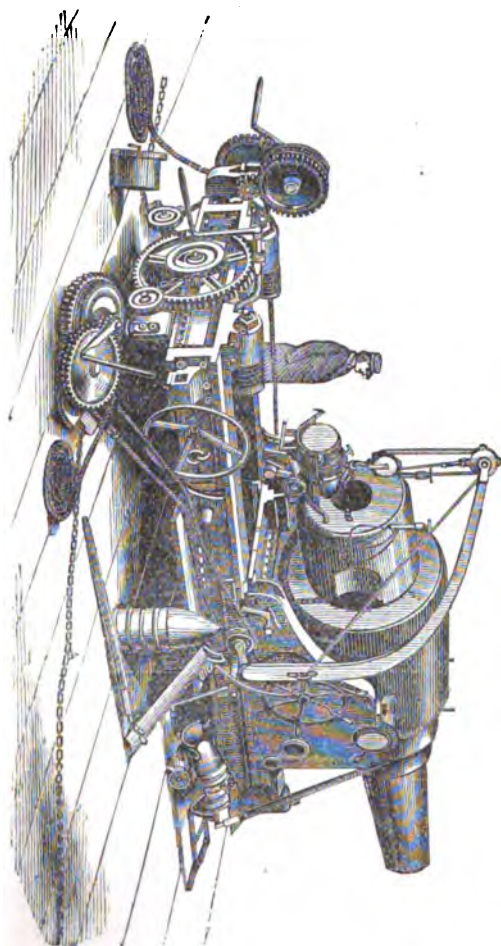
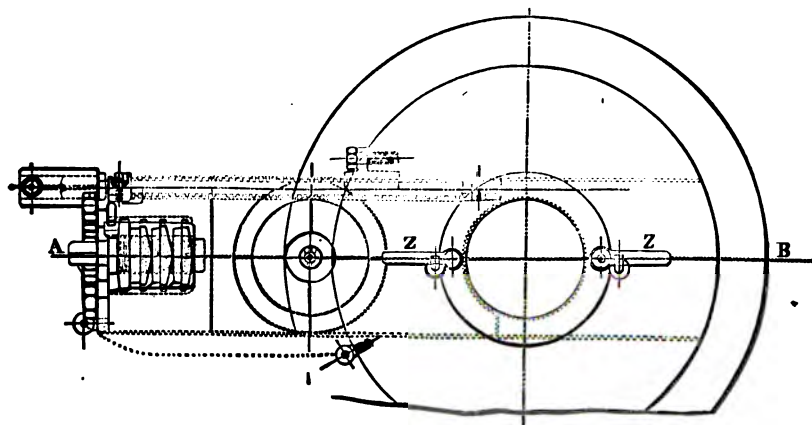
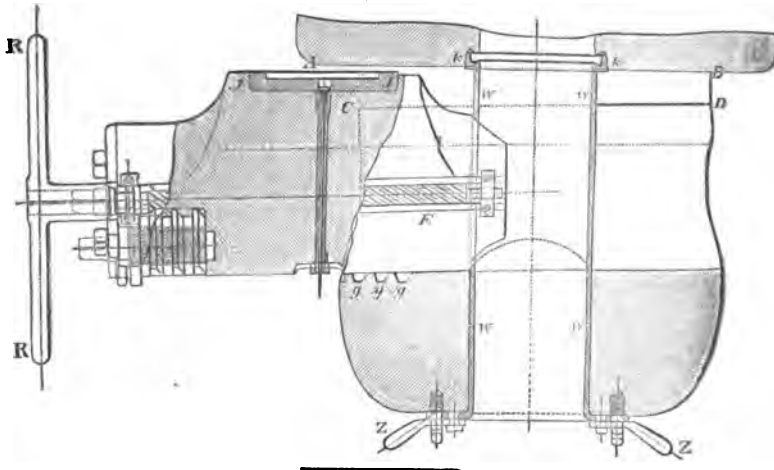




Fig. 2.



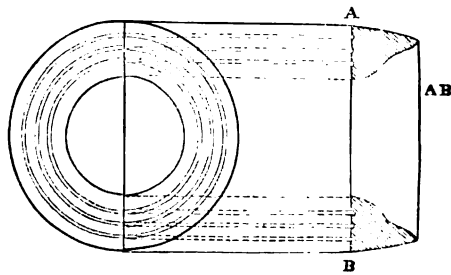
*Rifle Grooves
at Loading Chamber*



at the Muzzle



Fig. 3.



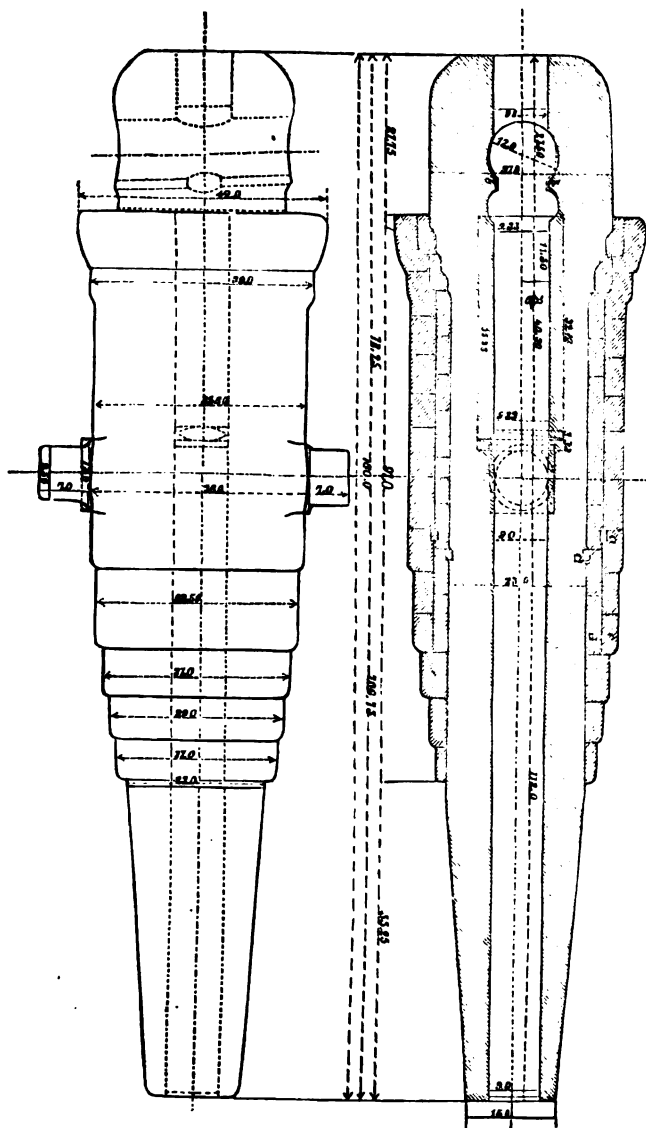


Fig. 4

The following table presents some of the details of this ordnance :

Caliber.	Rough tube ingot.		Weight of finished gun.	Weight of projectiles.	Weight of powder-charge.	Relations.		Number grooves.	Twist, 1 turn in inches.
	Weight.	Diameter.				Weight of shot to gun.	Weight of powder to shot.		
Inches.	Tons.	Inches.	Tons.	Pounds.	Pounds.				
6	10	28	3½	81	15	1-107	1-5.4	24	.....
8	15	34	9	209	36	1-107	1-5.1	32	.....
9	20	41	1¼	297	46 to 52	1-121	1-6.4 to 1-5.7	32	540 to 552
11	30	45	2¾	495	88	1-120	1-5.5	36	770 to 788
14	50	.....	55	1,000	185	1-124	1-5.3	40	980 to 1,014

No. 60.] [Fried. Krupp, & Essen, (Prusse,) Gussstahl-Fabrik. American office, 15 Gold street. P. O. Box 2,878.]

NEW YORK, July 24, 1872.

SIR: We are authorized by Mr. Krupp, under date 6th instant, to make the following proposition: He will place free, at the disposal of the board, either a 9-inch or an 11-inch gun, on coast-carriage, with projectiles up to fifty rounds, for the purpose of the trials contemplated. Either of these sizes can be furnished at short notice. The board to pay cost of transport and all expenses of the trials, the gun and carriage to remain the property of Mr. Krupp. The only conditions Mr. Krupp attaches to this offer are, that he shall be furnished with a programme of the trials before the gun is forwarded, and that one of his representatives shall assist at the trials. Mr. Krupp also proposes to send for trial at the same time, and on same terms, one of his field-guns, if agreeable to the board. If the board are committed to any other caliber, we presume Mr. Krupp would be willing to meet their views in that respect, though 9-inch and 11-inch, being standard sizes, could possibly be furnished more readily than any other.

We inclose table of *approximate* prices for guns at Essen, and remain, yours, respectfully,

THOS. PROSSER & SON.
A. MOORE.

Major SILAS CRISPIN, U. S. A.

[Inclosure.]

NEW YORK, July 24, 1872.

Approximate prices (gold) for guns delivered at the works.

Caliber, inches.	Gun.	Coast-carriage.	Total.
9	\$15,250 00	\$4,750 00	\$20,000 00
10	21,000 00	6,000 00	27,000 00
11	29,800 00	7,200 00	37,000 00
12	38,500 00	10,000 00	48,500 00

Projectiles, each.

Caliber, inches.	Steel shell.	Chilled-iron shell.	Common shell.
9	\$60 00	\$45 00	\$15 00
10	80 00	60 00	20 00
11	100 00	75 00	25 00
12	150 00	100 00	30 00

THOS. PROSSER & SON.
A. MOORE.

[Indorsement.]

UNITED STATES ORDNANCE AGENCY,
New York, July 25, 1872.

Respectfully referred, together with its inclosures, to the board on heavy ordnance convened by General Order No. 57, dated June 28, 1872.

S. CRISPIN,
Brevet Colonel, U. S. A., Major of Ordnance.

No. 69.] [Fried. Krupp, à Essen, (Prussia,) Gussstahl-Fabrik. American office, 15 Gold street. P. O. Box 2,878.]

NEW YORK, August 5, 1872.

SIR: Under date July 20, and referring to your application for specification of 12-inch gun, Mr Krupp writes as follows:

"The new construction of this caliber is not yet tested. Gun and carriage are now finished, and trials will be made here this year. As soon as decided on I shall give you notice, so that American officers can assist the trials.

"If I send a gun, I understand it to be for a trial of the system, and not for a competitive trial of calibers. Sufficient trials have been made with this intention at Berlin and Vienna. The gun I send must be tried for what it is—a *representative of my system*.

"To avoid complication, I will send shot and shells, as many as required, portion of it to be paid for. Prismatic powder must be sent too. About two months will be required to finish the carriage for the 11-inch gun."

It appears from this that a 12-inch gun could not be furnished very soon, but as the views expressed by Mr. Krupp doubtless coincide with those entertained by the board, we presume an 11-inch gun will answer equally as well in a trial of "systems."

We remain, yours, respectfully,

THOS. PROSSER & SON.
A. MOORE.Major SILAS CRISPIN, U. S. A.,
Board on Heavy Ordnance.

[Indorsement.]

UNITED STATES ORDNANCE AGENCY,
New York, August 5, 1872.

Respectfully referred to the board on heavy ordnance, convened by General Order No. 57, dated June 28, 1872.

S. CRISPIN,
Brevet Colonel, U. S. A., Major of Ordnance.

ALEXANDER T. LOYD.

H. O. No. 3 c.]

CHICAGO, May 6, 1872.

SIR: In 1869 I made application for an opportunity to present for examination a novel method of constructing ordnance, receiving in the matter letters from your Department under dates of July 27, (or 29,) 1869; March 22, 1870; June 2, 1870; February 15, 1871, together with a copy of Brevet Major-General Barnard's report to you, under date March 22, 1870. The action of the board of officers, convened March 21, 1870, on my application, is set forth in Ordnance Memoranda No. 10.

My object has been to submit for examination a description and model of my proposed method of constructing cannon, claiming increased endurance, ability to vastly increase the present caliber without lessened safety, &c., &c., at diminished expense.

Through a mistake in addressing the letter of March 22, 1870, I did not receive it in time to submit my plans to the board then in session.

Having since changed my address, I desire to now place my *new address* in your hands, so that when a suitable opportunity for presenting my invention occurs, it may receive proper notice.

Trusting you will kindly cause this new address to be so recorded that no mistake may again occur, I remain,

Very respectfully,

ALEX. T. LOYD,
103-105 South Canal street, Chicago.Brevet Major-General DYER,
Chief of Ordnance, Washington, D. C.

[The above letter was referred to the board by the Chief of Ordnance, under cover of his letter of July 8, 1872.]

H. O. No. 12.]

CHICAGO, July 8, 1872.

SIR: I have this day forwarded by Adams's Express, two communications relative to improvements in serving ordnance, desiring to submit them to the board of officers for examination.

Very respectfully,

Colonel R. H. K. WHITELEY.

ALEX. T. LOYD.

[Inclosure.]

CHICAGO, ILLINOIS, July 6, 1872.

GENTLEMEN: I herewith respectfully submit my plan for constructing ordnance. I have refrained from taking out a patent thereon, believing that its merits, if any, would be enhanced by remaining a secret with the Government until such time as needed for actual service.

Very respectfully,

ALEX. T. LOYD.

The BOARD OF OFFICERS.

P. S.—If advised that it is desired I appear personally to explain my invention, I will immediately do so.

To the Board of Officers:

JULY 6, 1872.

GENTLEMEN: The cannon I have invented may be briefly described as a cylinder formed of independent transverse sections, held in position by lateral rods or ties, extending from the terminal muzzle-section to the terminal breech-section. The argument upon which the justification of the principle rests, is, that the power required to prevent the lateral separation of such disconnected sections forming a cylinder, is correspondent to the *inclosing* strength of an individual section. Hence, in the gun, if sections A B, severally competent to withstand a ruptive force exerted from within outwardly, (which force may be represented by, say, one hundred tons,) are held together by tie-rods, whose combined strength is sufficient to resist a lateral strain of, say, one hundred tons, the liability of lateral separation among the sections so restrained is no greater than their individual liability to outward rupture when the gun is fired.

The illustrative model sent herewith is sufficiently accurate to render intelligible the following more particular description of my proposed ordnance.

The essential component parts of my gun are four in number, viz, the body-sections (A B,) the terminal sections (C D,) the tie-rods (F,) the bands (E.)

The body-sections have the form that would result from erecting an isosceles triangle upon the circumference of a cylinder, with respectively its shortest side, (as in B,) or its most acute angle (as in A) in contact therewith, and at right angles with the length thereof, and prolonged upon the surface of the cylinder until a complete circle has been described; or, so to speak, the sections may be termed circular isosceles triangles, whose equal sides form the faces of the sections, and whose unequal sides form the inner and outer surfaces of the gun. The so-called isosceles-triangle sections, as shown by the model, are not quite true to their names, in that the sides are stopped short of forming an acute angle.

For convenient designation I shall name those sections having their bases outward, forming the greater portion of the exterior of the gun, major sections; and those having their bases inward, forming the greater portion of the interior surface of the gun, minor sections.

The major sections, (A,) whose form is exhibited by the model, should be of the toughest and strongest material possible, as evidently the strength of the cylinder depends in a great measure upon them, for the minors can be ruptured only by forcing their way through the overlapping majors, the small portion of the minors (the shortest side of the so-called triangle) not so secured being afterward provided for. Wrought iron, cast steel, and the best and toughest cast iron may be employed in their manufacture.

The minor sections, (B,) forming the bore of the gun, should possess hardness and endurance, combined with strength to resist the percussive force and abrasion of the expelled projectiles. Cast steel, cast iron, or cast iron case-hardened, may be made use of.

The cast-steel and cast-iron sections may be formed by pouring the molten metal into suitable molds, and those of wrought iron may be forged in V-shaped swaging-blocks, subsequently finishing each kind in a lathe.

The terminal sections are the breech and muzzle pieces.

The breech-section (C) is either a major-shaped, with a bevel on the side adjoining

its neighbor body-section, and plane or somewhat convex on its outward side; or a minor-shaped, beveled on its interior and plane or convex on its exterior face. Either style may be adopted as preferred. My model employs the former. This section, unlike the others, is solid, not being penetrated by the bore.

The muzzle-section (D) may also have on the side adjoining its neighbor sections a major or minor section bevel, dependent upon the style adopted for the breech-section. Probably those in my model are as good as any.

These terminals are in diameter equal to the diameter of their adjoining body-sections, plus rather more than double that of the tie-rods to admit of inserting the latter into their projecting rims, for which purpose slots (G) are sunken into them until flush with the exterior of the gun. The projecting rims of these terminals must be of sufficient strength and thickness to furnish a "holding" strength, equaling the strength of all the tie-rods combined.

The tie-rods of wrought iron are designed to bind the sections together forming the gun. They extend from one terminal section to the other, and must possess, combined, an absolute strength to resist lateral strain, at least equaling the inclosing strength of the strongest section. Practically their endurance may be greatly in excess of this limit.

A neither end the tie-rods terminate in strong heads, forged "of a piece" with the rod itself, (not as shown in model.) The distance from the inside surface of one head to the inside surface of the other on the same rod is somewhat less than the actual distance between the outward faces of the terminal sections of the gun, so that when the tie-rods are elongated by the expansive effect of heat, their length will be just sufficient to permit them to drop into the slots prepared for them in the rims of the terminals. Contracting in cooling, they bind the sections together with vast and sufficient force. The expansion of the gun, under the heat generated by firing, will only more strongly hold the sections *in situ*.

If desired, especially in case of field-pieces, the rods may be made longer, and terminated with a head on one end, and a deep screw-thread on the other. Then, when the gun is prepared for the rods, force a long heavy nut up the thread, with a heavy wrench, until the sections are firmly secured. The former method is generally preferable.

The bands (H) are heavy broad hoops or rings of wrought iron, destined to be placed over the line of jointure between the sections. They are made somewhat less in internal diameter than the external diameter of the sections, over which they are forced and enlarged by heat until sufficiently expanded to pass over the sections to their proper place. Then cooling, they serve to give rigidity to the gun and effectually prevent any escape of gas where sections may not fit with exactness, and also secure such portion of the minor sections as are not overlapped by the majors.

In ordinary-sized guns they may be made sufficiently broad to cover the outward surface of the minor and liberally overlap the adjoining majors on either side. In excessively large guns a band may cover only half of the surface of a minor and overlap only, say, the right-hand major. A second band will secure the remaining half of the minor and overlap the left-hand major. Then, if desired, a third band may be thrown over the center of the first two.

The essentials of a gun having been thus provided, it may be built up in this manner or any other found desirable in practice.

A core of solid iron as long as the desired gun, and of the same diameter as the rough bore of the sections, has one end let into a wall or bumper, holding it suspended, and affording resistance to lateral pressure. The free end of the core rests upon a movable support. A section, say a minor, is slipped along this core until it rests against the bumper. A major section follows. This core is provided with a set of jack-screws so arranged (description of which is unnecessary) that great pressure may be applied to the last section, forcing and holding it firmly against its predecessor, yet offering no resistance to the passage of the band or hoop which is to follow. This band, previously heated, is then placed over the line of jointure, and hammered snugly down upon the gun, and then allowed to cool.

A minor and major section follow; the jack-screws again force them into close contact, and a broader band, sufficient to cover the face of the minor and overlap the majors, placed in position. When the gun is thus built to a sufficient length the breech and muzzle sectional pieces are placed in position and pressure applied at either end, while bands are welded over the line of meeting between the terminals and body-sections.

The connecting or tie rods are now elongated by heat until they will fall into their proper slots. Over these rods may be sunken several bands, girthing them all, to hold the rods well down upon the gun, and by so doing give rigidity to the piece, preventing any possible tendency to "sag," which, however, I scarcely fear after the bands are in place. Should this "sagging" exhibit itself in the very largest guns, hollow cast-iron tubes or pipes may be laid parallel with the tie-rods, and other bands shrunken over all. And if even all this was insufficient, the sides of the sections, say at a point

one-third the distance from exterior to interior of the walls of the gun, might be grooved or channeled to a depth of half an inch or more, the crevice having a width of, say, half an inch or an inch, (these dimensions will vary with the size of the gun.) A hoop of wrought iron, in width equaling the depth of this groove, in two sections, and in thickness the same as the width of these grooves, may then be forced into this crevice of one section, and the next section placed in position.

The result would be that the crevice is filled with the band, and neither section can alter its position.

This diagram, Fig. 1, will illustrate my meaning.

When the gun is so built up the bore may be trued out in a lathe as if the piece had been cast entire.

The number of tie-rods required will vary with the size of the gun, as will the size of the rods themselves. From three to seven will cover the majority of cases.

If it should result that forming the gun of so many individual pieces impairs the unity and accuracy of the bore, (which I do not anticipate,) this objection may be overcome in several ways, as:

First. The major sections may be stopped short of entering the bore, and the minors having passed the termination of the majors, will be extended laterally to fill the space formerly allotted to the interior end of the majors. This would give them shapes as shown in Fig. 2.

Second. The bore having been first "trued out," a cast-steel or wrought-iron tube may be inserted, and (in this sectional gun easily fastened) forming a bore "all of a piece."

Third. The inner surface of the gun may be left ragged, and, if desired, the major sections may be made to project a sufficient distance into the bore beyond the base of the minors. The bore is then filled with molten iron, and, after cooling, dressed out. This is the preferred method. When the bore is so large that the metal will shrink away from the walls of the gun in cooling, a core can be inserted forming a rough bore; and the metal may be cooled by the plan employed in casting the Rodman gun. The unevenness of the ragged bore, especially if made purposely ragged, will afford ample hold for the molten iron. This latter plan would also absolutely prevent "sagging," and I regard it as very important, especially in the largest pieces.

It might be found desirable, in building guns of the heaviest caliber, to first form a preparatory cylinder of sections as for a perfect gun, heretofore described, but with walls of an even thickness from breech to muzzle, instead of varied thickness as ordinarily. Then, instead of banding and finishing the piece, dress the exterior perfectly true in a lathe, and place upon this first cylinder a second series of sections, "breaking joints" with the first, of varying thickness from breech to muzzle, with a trued internal diameter exactly fitting the exterior circumference of the first cylinder. This would give two complete sets of sections, obviating any considerable mass of iron in any one casting or forging.

Another method of forming a gun is to make all the minor sections of cast iron or cast steel, and all the major sections of wrought iron—the latter being a little less in diameter than is required to fit snugly upon the minors. Then place all the majors into a furnace and heat until expanded. Place these and the cold minors alternately upon the core and quickly put in position the tie-rods. The cooling of the majors, resulting in their consequent contraction, would bind the gun more firmly together than if formed of a single piece.

If it be desired to form a homogeneous gun, make all the sections of wrought iron; then, heating to the welding temperature, unite them under a steam-hammer, either section by section, if the gun is large, or in a mass if small, subsequently bringing the whole fabric to a proper temperature, and placing under a steam-hammer until thoroughly united.

The advantages of having the line of jointure between the several sections not at right angles with the length of the gun are so evident in welding that I need not enlarge upon them.

Among the many advantages I claim for my method of constructing ordnance, may be enumerated these:

In such comparatively small castings and forgings as of individual sections, flaws and imperfections are avoided, or, if found present, only a small portion instead of the entire construction is wasted.

Its pre-eminent economy. The manipulations of small masses of metal is attended with much less expense per pound than of large ones.

Again, when, as invariably happens, one portion of a gun is worn out in service or damaged by accident, while the remainder is yet serviceable, the worthless portion in my gun can be replaced, instead of condemning the whole, as now.

It is evident that my method admits of indefinitely increasing the size of a gun, even to enormous and hitherto unattempted dimensions, without as now correspondingly increasing the danger attendant upon its use.

Ordnance can be shipped to places difficult of access, and then combined; or, in ser-

vice, a gun can be carried by men to points otherwise inaccessible, then combined, and used against the enemy.

Aside from the economical gain of ordinary repairs which has been mentioned, is that of repair at distant points in service, as when a vessel is on foreign service, in time of war, if a portion of her few heavy guns is destroyed in action or by service, the wanted section can be carried aboard and put in place. It is evident that only the breech-sections will be worn, and only the muzzle-sections injured by the enemy in armored ships, and these two, or these endangered sections, can be carried in duplicate. Or, if the armament of an endangered fort is partially destroyed, the wanted portions can be telegraphed for to the nearest depot of supplies, and quickly forwarded, as are parts of sewing-machines and reapers to-day.

The foregoing description of my method of constructing ordnance is in many respects incomplete, and I desire that it may be construed rather as a memorandum of my invention than a full and restricting definition. If I have left any material point untouched or obscure, I will, when so advised, endeavor to make it plain.

Very respectfully submitted.

ALEX. T. LOYD,
103, 105 South Canal Street, Chicago, Illinois.

No. 87.]

JUNE 8, 1872.

To the board of officers :

GENTLEMEN: It is well known that the powder forming the charge of a large gun is only imperfectly consumed when the piece is discharged; the cause (it is unnecessary to mention, perhaps) being the lack of sufficient air (oxygen) within the small area forming the bore, to thoroughly accomplish the combustion of the powder. The consequence is a failure to gain any satisfactory and sufficient result from increasing the amount of powder in the charge.

To overcome this difficulty, and to also admit of indefinitely increasing the charge of powder in the heavy-metalled guns of comparatively small bore, for the purpose of throwing projectiles with extraordinary force against armored ships, &c., or to unusual distances, as in bombarding forts or cities from afar off, is the object of the invention I will now describe.

Description.—A tube or other shaped casket of metal (tin, copper, or iron) is filled with compressed air, or with oxygen, and then securely sealed to prevent its escape. This casket of air is placed within the powder forming the charge. The discharge of the gun breaks the walls of the casket, liberating the air or oxygen, which is contained in sufficient quantity for the perfect combustion of the powder. The fragments of the casket are, of course, thrown out from the gun, and its walls not requiring much strength, but little metal need be employed; hence no danger is anticipated from the pieces thrown out. The case would probably give the best results if made of copper.

The plan is so very simple that a model is quite unnecessary, the diagram, Fig. 3, sufficiently illustrating the idea.

Other shapes will suggest themselves, but without affecting the principle. For instance, in conical shot the air or oxygen may be retained at the base of the projectile, or the casket may be formed of two disks connected by a hoop or circular band at their circumferences, allowing space between for the reception of the air, and placed between the powder and the projectile; but the method first described seems much preferable. The cost of manufacture would, of course, be merely trifling, and, when completed, the caskets might be stored for years without injury. The sizes required would vary with the quantity of powder employed.

I would suggest an experiment with miniature caskets in musket-cartridges as well. If found of value, a place for the reception of the air could be arranged in making the copper shell now used.

Very respectfully submitted.

ALEX. T. LOYD,
103, 105 South Canal Street, Chicago, Illinois.

No. 87.]

JUNE 8, 1872.

To the board of officers :

GENTLEMEN: I beg leave to forward the following plan for—

First. Lessening the strain upon the walls of heavy guns when in service.

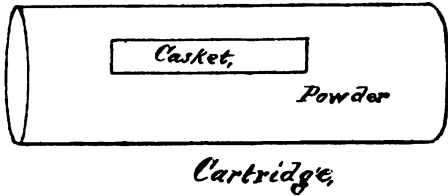
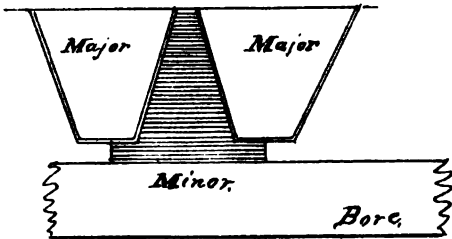
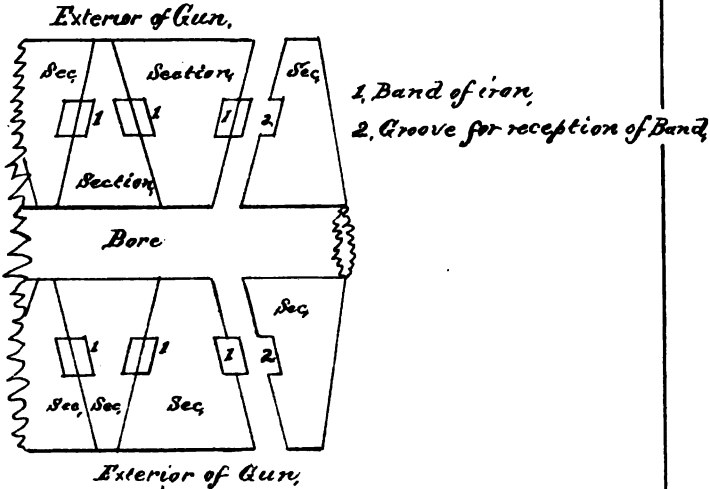
Second. Lessening the recoil.

Third. Increasing the range or distance the projectile will be thrown.

My plan is simply to exhaust the air from the gun, after it has been loaded, by means of a suitably adapted air-pump.

A tampon of wood, lined on the face, intended to rest on the muzzle, with leather

ALEX. T. LOYD'S METHOD.



felt, rubber, or other suitable packing, and penetrated by a tube, with a valve placed over the muzzle of the gun. Then, the vent-hole being stopped, the air is pumped out, and the valve turned, creating a vacuum. The pressure of the outside atmosphere would retain the tampion in position.

When the gun is discharged, the casket containing air, as described in my other communication of this date, is broken, liberating oxygen for the combustion of the charge of powder.

The expected gain is the absence of the column of air in the bore of the gun, which, aside from its normal resistance, is compressed by the outgoing projectile, so that in large pieces the power required to overcome its resistance is a serious drawback from the range otherwise obtainable, and by just so much are the walls of the gun needlessly strained.

The application of this principle would probably be limited to siege and ships' guns.

Very respectfully submitted.

ALEX. T. LOYD,

103, 105 South Canal Street, Chicago, Illinois.

A. S. LYMAN AND ALBAN C. STIMERS.

L. B. No. 9.]

ARMY BUILDING, NEW YORK, July 12, 1872.

SIR: I have the honor to inform you that the board on heavy cannon desires such information as you are able to furnish respecting the Lyman multicharge gun.

Very respectfully, sir,

R. H. K. WHITELEY,

Colonel of Ordnance, President of Board.

The CHIEF OF ORDNANCE.

No. 39.]

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, July 13, 1872.

SIR: In compliance with your request of 12th instant, I transmit herewith report of trial of the Lyman multicharge or accelerating gun, at Reading, Pennsylvania, in 1870, being the only source of information respecting the same on the files of this office.

Respectfully, your obedient servant,

By order of the Chief or Ordnance.

S. V. BENÉT,

Major of Ordnance.

The PRESIDENT OF THE BOARD ON HEAVY ORDNANCE,
Army Building, New York.

[Inclosure.]

FRANKFORD ARSENAL, August 8, 1870.

SIR: In conformity with your order of the 21st ultimo, directing me to witness and report upon the firing of an accelerating gun at Reading, Pennsylvania, I have visited that city, with the necessary apparatus for determining the velocities and pressures developed, and have the honor to submit the following report:

Description of the Gun.—The gun is designated by its present proprietors as the "Multicharge 100-pounder rifle gun." It belongs to the class of accelerating guns, where the projectile receives an additional impetus after being started from its seat; and to the system known as "Lyman's," of which samples have been experimented with at Washington navy-yard and elsewhere.

Described by the usual formula, it is a rifled breech-loader, caliber 6 inches; of cast iron; weight, 10,175 pounds; No. 1 of its series; cast October 12, 1869, at Reading, Pennsylvania, by Seyfert & McManus, under supervision of Mr. Alban C. Stimers, naval engineer; without names or marks inscribed. Condition: had been fired once with 17 pounds of powder and 57-pound shot; once with 25½ pounds of powder and 77-pound shot; once with 32 pounds of powder and 90-pound shot; and twice with 30 pounds of powder and 90 and 92 pound shot, the only effect of which practice on the gun had been to crack the steel plugs of the two front pockets hereafter described, which plugs were replaced by bronze ones before any trials for pressure, &c., were made. Vent, through the breech-plug, horizontal. Four accelerating charges in pockets along the bore.

The peculiar characteristics of the gun can be best understood from the annexed drawing, reduced from working drawings at the foundry.

The breech-closing mechanism is nearly identical with the Whitworth system, the main difference consisting in the withdrawing wheel being so arranged as to revolve through a considerable arc before it begins to rotate the breech-screw, thus allowing of some *ris tiza* being accumulated before the act of starting the screw occurs.

Along the lower element of the gun, four globes of 1 foot 6 inches exterior diameter are cast, coalescing into the general form of the gun and into each other, all abrupt re-entrants being filled in and reduced to easy concaves.

The globes occupy that portion of the length of the gun between the position of the front of the shot and a point half way to the muzzle. They were cast solid, as was the entire gun, bored spherically to a diameter of 8 inches by an expanding drill from the bottom. The apertures necessary for the introduction of the drill ($3\frac{1}{4}$ inches diameter) were subsequently tapped, and closed with steel plugs, which were themselves bored and tapped for $1\frac{1}{2}$ -inch plugs, to enable the pockets to be cleaned. These latter apertures were used for applying the pressure-plugs in determining pressures.

Throats 4 inches in diameter connect the spherical cavities of these globes with the bore of the gun, thus forming the "pockets" used for the accelerating charges employed.

These charges are introduced through loading-holes closed with conical valves, operated by the small wheels and screws represented in the plan. The position of these loading-holes, with reference to the bore, is best shown in the transverse sections.

The rifling, as seen in the half-size section annexed, is peculiar and not easy of description in terms usually employed. The width of the lands bears a very insignificant proportion to that of the grooves, which latter are regarded as the bore proper in stating the caliber at 6 inches. It is proper to state that the section of the bore represents truly only that portion of it behind the front or fourth pocket. Beyond that point the non-bearing side of the lands is made more abrupt, with a view to permitting the flame to pass the projectile for the ignition of time-fuses. The twist is uniform—one turn in 10 feet.

The shot is cast with recesses for the lands. Its ends are alike, being "Ogilvie heads"—the element struck from a radius equal to the diameter of the shot. The cylindrical portion of the shot is 10 inches in length, the conoidal ends each 5 inches; total, 20 inches. The weight is 100 pounds; the surface as originally cast, except the curved ends, which were turned down in adjusting the weight. No expanding or gas-checking device is attached to the shot, which has a windage 6.1 inch to .15 inch.

The provision for preventing the gas of explosion from passing beyond the shot—a condition vital to the whole theory of the gun—consists of a wad formed of a number of thicknesses of straw binders' board, sufficient to produce a total thickness of $4\frac{1}{2}$ inches, the planes of the boards being transverse to the axis of the gun. These binders' boards are secured together by three light copper bolts, which also serve to retain an expanding copper-cup gas-check on the rear face of the wad. The whole affair is shaped carefully to the form of the grooves and lands—its length, it will be observed, being slightly in excess of the diameter of the throats of the pockets. This "lap" is obviously necessary to prevent the flame from "cutting by" the wad as it passes the successive *embouchures*. The wad is thus particularly described, because it would appear that to its failure to perform the important functions intrusted to it is attributable the fact of the gun on trial having yielded results entirely incompatible with the theory and expectations of its projectors.

The powder used in firing the gun with its full charge consists of, first, a small cartridge, 2 pounds of mammoth-powder, contained in a hat-shaped copper case, fitting the chamber in rear of the shot, and four other charges, of 7 pounds each, of navy cannon or rifle powder, contained in the four successive pockets.

No special carriage had been constructed for the gun. During the trial it was mounted upon two wooden cheek-pieces placed upon a four-wheeled railway-truck, which recoiled upon rails inclined upward at an angle of $2^{\circ} 30'$ for some 40 feet. The estimated weight of this truck-carriage was 1,200 pounds; its wheels were 1 foot 6 inches in diameter, and were chocked in all firings with full charges.

On the 21st of July, before the electrical apparatus for determining velocities had been erected, the gun was fired once with full charges in the presence of the officers ordered to witness the trial, the object being merely to show that everything about the gun was in proper working order. On this occasion 28 pounds of navy cannon-powder and 2 pounds of mammoth were fired with a hundred-pound shot; which, in a cast-iron gun of 10,000 pounds, certainly seemed a remarkable feat. The loading and sponging by six workmen from the foundry, not specially drilled, occupied about one minute and thirty seconds. Four of the party were employed in loading the pockets, and two in sponging and loading at the breech. The only manner in which the gun was affected by this shot, and the five firings with partial and full charges which had preceded it, was the cracking of the steel plugs used to close the apertures in the bottom of the two front pockets made by the original boring-tool, as already stated. These

plugs were about the only part of the gun where steel entered into the construction, and its unfitness for the purpose was strikingly illustrated by the molecular condition of the fragments when, by tedious labor, they were removed, to be replaced by bronze plugs.

On the 2d of August, the new bronze-plugs having been inserted, and arrangements for taking velocities and pressures being complete, the gun was fired six times under the circumstances and with the results described in each case, as follows: The officers present were Commodore Hitchcock and Commander Temple, of the United States Navy, and the writer.

The instrument used for determining velocities was the Green-Vignotti pendulum, of Frankford arsenal, arranged with a single-loop circuit through both targets, and started by rupturing wire at the muzzle; the interval was 100 feet, and began 30 feet from the muzzle.

The instruments used for pressures consisted of two exterior pressure-plugs, which were applied to the apertures at the bottom of different pockets, as described. The small compass of the breech-charge, and the fact that the vent of the gun was, according to the Whitworth system, in the prolongation of the axis of the bore, precluded the use of the interior pressure-plug.

The mounting and circumstances affecting recoil have been already described.

The density of the navy cannon-powder used was 1.7044.

First fire.—Breech-charge only used; 2 pounds mammoth-powder, 100-pound shot. Pressure-plugs applied to the first and fourth pockets, counting from the breech. Truck-wheels free.

Pressures, pounds per square inch.		Velocity.			Recoil.
First pocket.	Fourth pocket.	First arc.	Second arc.	Feet per second.	Feet.
4,500	2,000	(*)	(*)	(*)	54

* Not taken, too slow for limits of the pendulum.

Second fire.—Breech-charge 2 pounds mammoth-powder, and the first pocket-charge 7 pounds navy cannon-powder, other pockets empty. Pressure-plugs applied to first and fourth pockets. Truck-wheels free.

Pressures, pounds per square inch.		Velocity.			Recoil.
First pocket.	Fourth pocket.	First arc.	Second arc.	Feet per second.	Feet.
8,000	5,400	1° 37'	55° 42'	709	22

Third fire.—Breech-charge 2 pounds mammoth-powder. First and second pockets 7 pounds each navy cannon-powder. Other pockets empty. Pressure-plugs applied to second and fourth pockets. Truck-wheels spragged.

Pressures, pounds per square inch.		Velocity.			Recoil.
Second pocket.	Fourth pocket.	First arc.	Second arc.	Feet per second.	Feet.
74,000	11,500	1° 6'	50°	741	26

Fourth fire.—Breech-charge 2 pounds mammoth-powder. First, second, and third pockets 7 pounds each navy cannon-powder. Pressure-plugs applied to second and third pockets. Truck-wheels spragged.

Pressures, pounds per square inch.		Velocity.			Recoil.
Second pocket.	Third pocket.	First arc.	Second arc.	Feet per second.	Feet.
21,000	78,000	1° 6'	34° 6'	950	34½

Fifth and sixth fires.—Breech-charge 2 pounds mammoth-powder, all four pockets charged with 7 pounds each of navy cannon-powder. Pressure-plugs applied to second and fourth pockets. Truck-wheels spragged.

No. of fire.	Pressures, pounds per square inch.		Velocity.			Recoil.
	Second pocket.	Fourth pocket.	First arc.	Second arc.	Feet per second.	Feet.
Fifth . . .	33,000	39,500	1° 8'	30° 18'	1,026	35
Sixth . . .	23,000	60,000	1° 18'	29° 30'	1,093	33

After the sixth shot the firing was suspended for the day. August 3, impressions were taken of the bore in the neighborhood of the mouths of the pockets. No material injury appeared to have been sustained by the metal at those points. The firing was resumed with full charges, as in the fifth and sixth shots of the previous day. Navy rifle-powder, however, was substituted for the navy cannon-powder previously used. The density of this navy rifle-powder was 1.677.

First fire.—Full charges in breech and pockets. Pressure-plugs applied to second and fourth pockets. Truck-wheels spragged. Interval used for velocities, 80 feet, beginning 50 feet from the muzzle.

Pressures, pounds per square inch.		Velocity.			Recoil.
Second pocket.	Fourth pocket.	First arc.	Second arc.	Feet per second.	Feet.
71,000	80,000	3° 36'	27° 30'	1,075	33

The trial was then closed at the request of the parties interested.

The large local pressures and moderate velocities developed in this trial, where precisely an opposite state of things might reasonably have been looked for, can only be explained by supposing that the pocket-charges in some cases become ignited before the projectile has passed over their *embouchures*.

This occurrence becomes possible, and in fact almost inevitable, if the wad at any stage fails in its functions. Distortion of any kind would induce this failure, and this distortion doubtless occurs in passing the first and second pockets. The moment the wad has advanced sufficiently to partially uncover the mouth of the first pocket, the explosion of the charge in that pocket in all probability tears away more or less of the rear of the wad, whose structure, laminated transversely to the bore, would facilitate this disruption. The wad, unless of sufficient length to more than cover the mouth of a pocket, will permit flame to escape to the front in passing it, and a pocket-charge is doubtless sometimes exploded while its mouth is wholly or partially closed by the projectile in the act of passing over it, thus registering an enormous pressure in that particular pocket, with no corresponding accession of velocity. That a pressure of 78,000 pounds should be developed in an advanced portion of the barrel, while parts nearer the breech experience one of only 21,000 pounds, would certainly seem to indicate that, at the place and instant of occurrence of the greater pressure, communication with the bore generally must have been cut off.

Total extinction of windage, until the fourth pocket is passed, is the *sine qua non* of this system of acceleration; and to the accomplishment of this object the efforts of its promoters should evidently be directed.

For the gun generally, they have evidently used great care in its fabrication and in the selection of materials. They have embodied the Lyman principle in a much more slightly gun than any that have heretofore illustrated it. Neither its length nor weight are excessive for its caliber, even regarding it as a single-charge gun. When mounted, it exhibits none of the uncouth features which have hitherto been deemed inseparable from the system.

The pressures endured, without damage, by the pockets, speak well for the material of the gun, which was produced as follows:

	Pounds.
Hamburgh	1,850
Juniata	1,850
Cumberland	2,425

	Pounds.
Richmond No. 1	2,733
Richmond No. 2	2,733
Richmond No. 3	2,733
Remelted	2,300

Total charge	16,624
Excess remaining	2,000

Coal used :

Broad-top bituminous	5,860 pounds.
Fire started October 12, 1869	8 ^h 40 ^m a. m.
Metal fused	1 ^h 40 ^m p. m.

Remainder fused	5 ^h 5 ^m
Time consumed in filling	1 ^h 33 ^m
Cooling in mold	3 ^m
Length of sinking head	10 days.
Cast solid.	2 feet.

Mechanical tests—Sinking-head—Three specimens around the prolongation of the bore.

Number.	Breaking-strain, pounds per sq. inch.	Density.
1.....	28,055	7.947
2.....	28,745	7.959
3.....	28,754	7.958

Specimen from center of bore at muzzle.

Breaking-strain, 28,580 pounds per square inch. Density, 7.255.

Body of gun—Specimens taken from the throats of the pockets next the bore.

From rear.	Breaking-strain, pounds per sq. inch.	Density.
First pocket	26,968	7.251
Second pocket	26,615	7.230
Third pocket	27,550	7.238
Fourth pocket	Not obtained.	7.244
Bottom of casting	33,245	7.248

Weight per square inch of entire gun, 0.262 pound.

Dimensions, from the foundry records.

	Intended.	Actual.
Diameter of base-ring, turned.....inches..	20	19½
Diameter next to base-ring, rough.....do.....	18	17 15-16
Diameter at first pocket, rough.....do.....	18	18 1-16
Diameter at second pocket, rough.....do.....	18	18 1-16
Diameter at third pocket, rough.....do.....	18	17½
Diameter at fourth pocket, rough.....do.....	18	17 15-16
Diameter 1 foot beyond fourth pocket, turned.....do.....	17½	17½
Diameter 2 feet beyond fourth pocket, turned.....do.....	15½	15½
Diameter 3 feet beyond fourth pocket, turned.....do.....	14½	14½
Diameter 4 feet beyond fourth pocket, turned.....do.....	13½	13½
Diameter 5 feet beyond fourth pocket, turned.....do.....	13½	13½
Diameter of trunnions.....do.....	6	6
Length of trunnions.....do.....	3	3
Length between rim-bases.....do.....	20	20
Length from face of muzzle to center of trunnions.....feet and inches..	6 5½	6 5½
Length of main casting.....do.....	11 1½	11 1½
Length of breech-screw.....inches..	5½	5½
Length of breech-ring.....do.....	4	4
Length of bore.....feet.....	10	10
Length of gun over all.....feet and inches..	11 6	11 6
Diameter, interior, of pockets, (spherical).....inches..	7½	7½
Diameter, exterior, of pockets.....do.....	18	18
Extreme projection of pockets below the symmetrical element of the gun.....do.....	12	12
Preponderance.....pounds..	150	.....

Respectfully submitted.

WM. PRINCE, *Lieutenant Ordnance.*Major T. J. TREADWELL,
U. S. Ordnance, Commanding.

Respectfully forwarded to the Chief of Ordnance for his information.

T. J. TREADWELL,
Major of Ordnance, Commanding.

FRANKFORD ARSENAL, August 12, 1870.

No. 42.]

141 CENTRE STREET, NEW YORK, July 19, 1872.

SIR: The gun I have the honor to submit to the board over which you preside, is the breech-loading multicharge rifle.

The multicharge system is the subject of a patent by A. S. Lyman. The rifling and the breech-loading arrangements are original with myself; and the gun, as a whole, has been designed by me, the proprietors of the Lyman's patent having appointed me as their agent to bring this system into use in this country.

The gun proper is of cast iron, and is not banded or hooped in any manner. The breech-cap, pocket, loading-hole, caps, and pocket-plugs are of bronze, that their screws may never rust and stick them fast.

The additional charges, of which there are four, are suspended beneath the bore in globular pockets of cast iron, which coalesce into the general form of the gun and into each other, forming a part of the main casting.

DIMENSIONS.

Caliber to bottoms of riflings, 12 inches.

Length of bore from face of breech-plug to muzzle, 24 feet.

Length of bore from base of main casting to muzzle, 24 feet 3¼ inches.

Extreme length, from rear of breech-cap to muzzle, 25 feet 4 inches.

Diameter under screw-thread of breech, 2 feet 8 inches.

Diameter at 3 feet forward of base, 2 feet 6 inches.

Diameter at fourth pocket, 2 feet 6 inches.

Diameter at muzzle, 1 foot 9 inches.

Internal diameter of pockets, 1 foot 4½ inches.

External diameter of pockets, 2 feet 6 inches.

Centers of ditto below center-line of bore, 2 feet 2 inches.

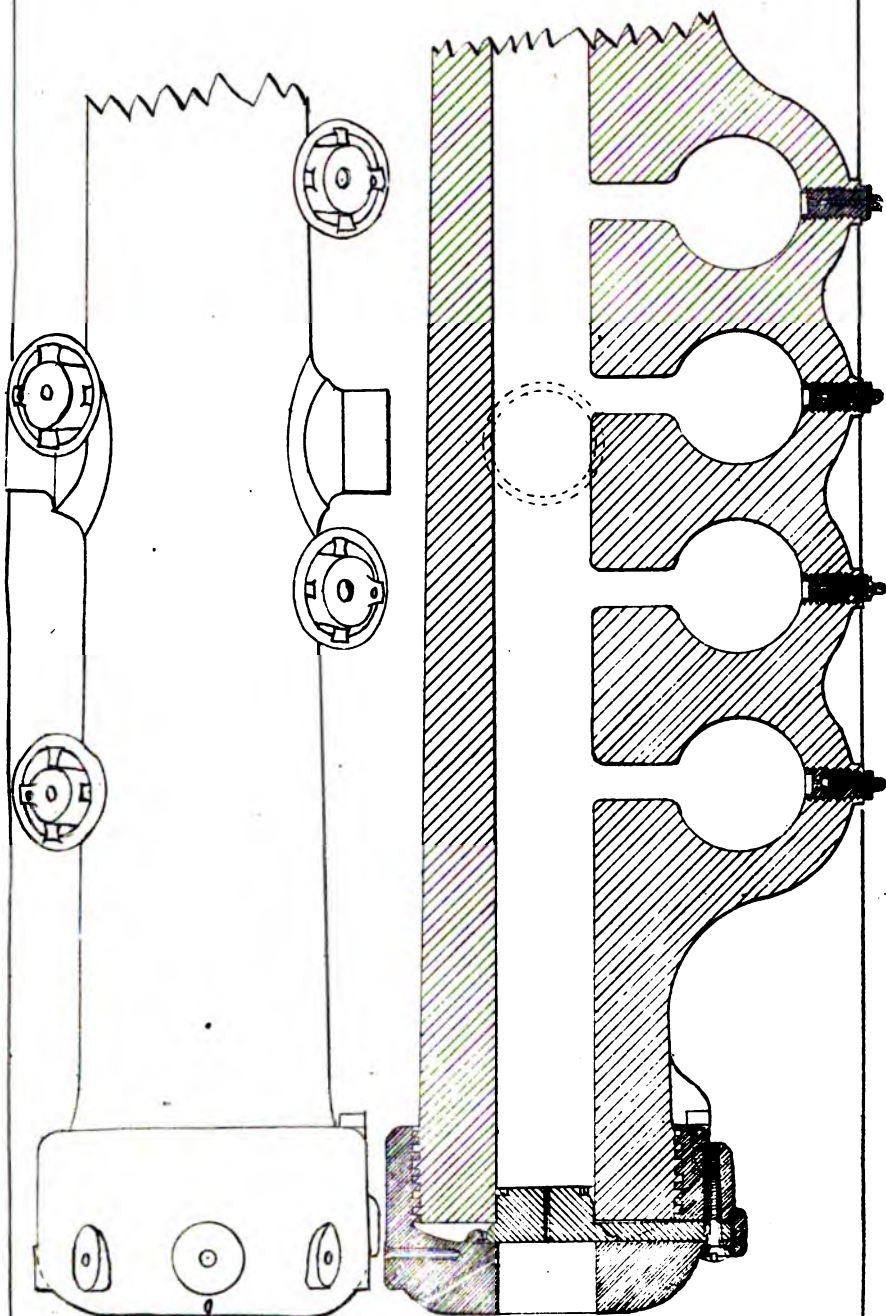
Diameter of pocket-throats connecting with bore, 4 inches.

Distance of center of first pocket from face of breech-plug, 4 feet 4 inches.

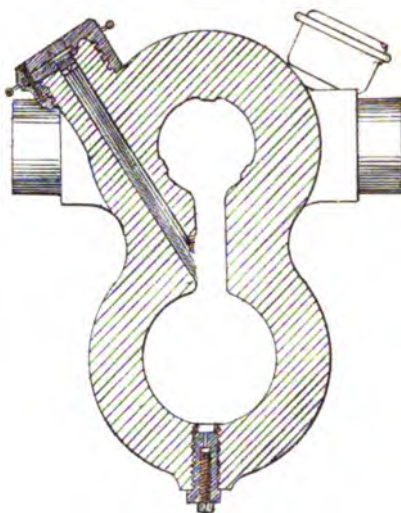
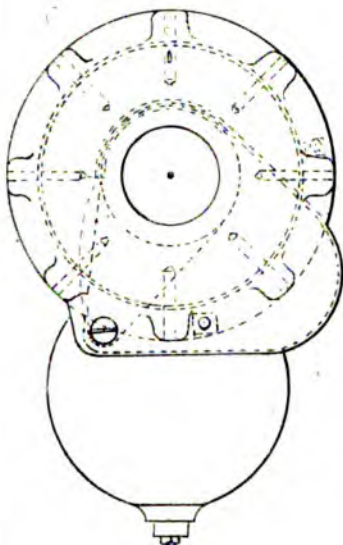
Distance of pockets apart from center to center, 2 feet.

Longitudinal depth, or thickness of breech-plug, 7 inches.

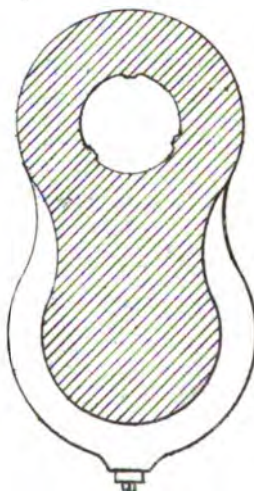
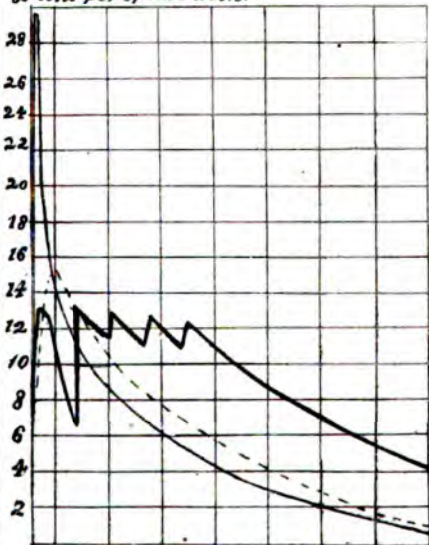
LYMAN'S 600 Pa. MULTICHARGE RIFLE.



LYMANS 600Pdr. MULTICHARGE RIFLE.



30 tons per square inch.



Longitudinal depth, or thickness of breech-cap in rear of plug, 9 inches.
 Outside diameter of breech-cap, 3 feet $3\frac{1}{4}$ inches.
 Longitudinal length of breech-screws, 12 inches.
 Pitch of screw, (4-threaded,) 6 inches.
 Twist of rifling, 1 turn in 36 feet.
 Estimated weight of gun, 25 tons.
 Weight of shot, 600 pounds,
 Weight of powder:
 Breech-charge, 60 pounds.
 Each pocket, 75 pounds.
 Total, 360 pounds.

OF THE MULTICHARGE PRINCIPLE.

From the date of the advent of the Armstrong gun, in 1855, to the present time, there have been innumerable efforts made in Europe and in this country to produce a breech-loading rifle of large caliber. As yet a satisfactory gun of this description is unknown; the existence of your board is a proof of this, and also of the fact that the search is still continued.

The first difficulties encountered with rifled cannon were the weakening effects of the rifling, and the greater strains to which guns throwing elongated shot were subjected. To overcome these it has been the uniform practice of every essayist for the production of the successful rifle, with the single exception of Mr. Lyman, to increase by some means the strength of the barrel, or at least to endeavor to do so.

The number of devices which have been proposed and tried, and the amount of engineering and mechanical skill which have been expended upon some of them, notably upon the Armstrong pattern, are among the wonders of the age. The English government has spent millions of treasure in this direction, and yet the barrel is not strong enough.

Quite recently the evil has been greatly mitigated by having given attention to the character of the powder employed, and observing the phenomena of its explosion within the gun. The late experiments on this subject in England illustrate the wisdom of Rodman's recommendation of the "mammoth" grain-powder.

Mr. Lyman's efforts have been in an entirely different direction. He has studied to bring the increased propelling force necessary upon the rear of the shot, without adding to the bursting strains upon the barrel of the gun. That it is reasonably possible to accomplish this becomes evident when we consider the manner in which the powder exerts its pressure within the ordinary gun.

The light line on the pressure diagram, herewith, and the dotted line, are reduced copies of two of the curves reported by the English board of experimenters on explosives, in their preliminary report, dated February 5, 1870. The heavy line represents the diagram which may be expected from the gun herein brought to your attention.

The light line was formed by firing 32 pounds of "rifled large-grain" powder in an 8-inch gun, behind a shot weighing 180 pounds.

The dotted line was formed by firing 35 pounds of "pebble No. 5" powder with the same gun and shot. It differs from the other only by the increased size of the grains, the specification of its manufacture requiring that it shall consist of the lumps which are retained between sieves of $\frac{1}{8}$ and $\frac{1}{4}$ inch mesh, respectively; the effect in the gun being to prolong the time required to burn it, sufficiently to permit the shot to move forward and slowly enlarge the space, so that by the time it is all burned, the fact of filling of the large space results in a less pressure than would have been exerted if it had filled only the space occupied before the shot began to move; while the charge of powder being greater, the mean pressure along the bore, representing the useful force exerted upon the shot, is also greater.

The resulting improvement is in the same direction as that proposed by Mr. Lyman, but is decidedly inferior, as is shown by the following table:

	Initial or bursting pressure.	Mean or useful pressure.
	<i>Pounds.</i>	<i>Pounds.</i>
English rifle large-grain powder.....	68, 750	12, 000
English pebble, No. 5, powder.....	34, 500	14, 400
Lyman's multicharge gun.....	30, 000	20, 600

It is proposed to employ "mammoth" powder in the breech-charge of the gun proposed, this being quite similar to the English "pebble," differing only in having somewhat larger grains.

In guns of this caliber (12-inch) it will, perhaps, be as well to use "mammoth" powder in the pockets; but in smaller guns, such as a 100-pounder, the shot would leave the muzzle before the powder in the fourth pocket was all burned; and, in every case, the small-grain powder may be used with propriety in the pockets, because the necessary space to prevent excessive pressures is already provided as the charge in each is ignited.

In estimating the initial velocity of the shot to be expected from a gun of this kind, it is evident that the ordinary empirical rules applied to the single-charge gun will not suffice.

Sir Howard Douglas, in his work on Naval Gunnery, page 43, gives a formula deduced from one by Doctor Hutton, which is approximately correct for a single-charge gun. It, however, contains an error which becomes important when it is applied to the multicharge gun. I have corrected this, and modified the terms to correspond with the professional language of the day, and the equations become—

$$V = \sqrt{\frac{2 g h r^2 \pi p M \log \frac{\lambda}{\lambda'}}{W \left(\frac{\lambda}{\lambda'} - 1 \right)}}$$

Where V = velocity of the shot in feet per second;

g = velocity due to gravity;

h = distance which the shot moves along the bore, in feet;

$r^2 \pi$ = area of the bore in square inches = 107;

p = initial pressure exerted by the powder, in pounds per square inch;

M = modulus of the logarithm of ratio of expansion of powder after combustion;

λ = space into which powder expands in terms of the length of the bore, in feet;

λ' = space occupied by powder before it expands and when exciting pressure p ;

W = weight of the shot.

The error referred to is that λ is taken to equal not only the space into which the powder expands, but also the distance which the shot moves along the bore. The error in the ordinary gun is simply that the shot moves a less distance by the length of the cartridge, and, with the single small charge of the smooth-bore gun, this is not very important; but when it comes to the great charges of the multicharge gun it would give the velocity considerably too high.

The value of M is erroneously given also, as it assumes that powder expands in the gun in accordance with Mariotte's law—that is, that the curve of expansion is a parabolic one, whereas it is a diabolic, and I have taken the value of M from Rodman's experiments, (see his report, p. 206.) These are not sufficiently extended to give its value with nice accuracy, but we know that it is less than 2.3, (the value given by Hutton,) and more than 1.87. As will be seen in the following table, I have assumed it to be 2 in each case. It is probable that this is too small in at least three of the cases, but cannot be materially so.

The values of the elements of the formula for the various charges are given in the following table:

Powder, pounds.		$\frac{2 g r^2 \pi}{W}$	h	p	λ	λ'	$\frac{\lambda}{\lambda'}$	M	$\frac{M \log \frac{\lambda}{\lambda'}}{\frac{\lambda}{\lambda'} - 1}$	V Point to point.	V At each point.
Breech	60	11.47	3	30,000	4.33	2.8	1.54	2	21,000	850	.....
First pocket...	75	11.47	2	30,000	8.33	6.33	1.32	2	22,500	718	850
Second pocket.	75	11.47	2	29,000	12.33	10.33	1.19	2	23,200	730	1,112
Third pocket..	75	11.47	2	28,000	16.33	14.33	1.14	2	22,600	721	1,330
Fourth pocket.	75	11.47	13.5	27,700	31.83	18.33	1.74	2	17,895	1,665	1,513
Total.....	360	.....	22.5	.....	.....	.....	.....	.....	At the muzzle .....	.....	2,850

It is now sixteen years since Mr. Lyman commenced to make experiments to test the merits of his invention, and have it brought into use.

It is probable that, if he had known how much care and skill were required to produce the most ordinary gun and have it surely good and reliable, he would hardly, with

his limited knowledge of the subject, have attempted so radical a change in the mechanical structure as is required to practically apply his invention to large guns. Having no conception, however, of the magnitude of his undertaking, he not only provided for several charges to be successively ignited in the rear of a single shot, but he also rifled his guns and made them breech-loaders. Deficient in mechanical knowledge of every kind, and especially so of that which relates to ordnance, it is not surprising that his guns violated every rule of proportion, were expensive to make, inconvenient to use, and exceedingly uncouth in appearance. Added to this he had trouble with his projectiles, as did every other promotor of rifled guns. He and his friend, Mr. Haskell, who has labored with him from the first, have, however, persevered whenever they could raise the means to prosecute their experiments. One after another of the innumerable difficulties with which they have had to contend have disappeared, until at this moment they have a six-inch gun at Reading, Pennsylvania, ready for trial, waiting only for the means to pay the expenses of firing it. When it was tried two years ago, the wad proved defective as a gas-check, and the pockets toward the muzzle were subject to excessive pressures while shut off from communication with the bore, and the velocities expected from the shot were not obtained, (see report of Captain Prince to Bureau of Ordnance, August 8, 1870.) New wads being prepared, it was again tried one year ago, and the breech-loading mechanism was blown off. This has now been remedied by the application of a newly-devised arrangement.

Mr. Lyman and his friend Haskell have never lost faith in the final success of this principle, because, whenever matters did go off without mishap, they always obtained evidences of velocity which fully met their expectations. I will state one instance only, as I have it in a copy of an official report made by Lieutenant-Commander M. P. Jones, United States Navy, at the Washington navy-yard, December 18, 1863.

The gun was of 2½ inches caliber, and had three pockets. The shot was hard steel, coated with brass, sharp-pointed head, flat rear, and weighed 19½ pounds. The charges were :

Breech, ½ pound cannon-powder.
 First pocket, 1½ pounds cannon-powder.
 Second pocket, 2 pounds cannon-powder.
 Third pocket, 2½ pounds cannon-powder.
 Total, 6½ pounds cannon-powder.
 Elevation of the gun 0°15'.

Fired at target distant 200 yards. Target made of one 5-inch plate of iron, backed by 18 inches of solid oak. Shot struck the target, passing through the plate and timber, making a hole of about its own diameter, and fell in the water about 100 yards beyond the target. Such a result requires no comment.

OF THE RIPLING.

In order that an elongated projectile, fired from a cannon, may follow accurately the line of aim, it is necessary that it should revolve around its longitudinal center of gravity. To accomplish this, the rifling of the gun must engage the shot bodily, as in the Armstrong and Whitworth guns. Fitting a disk at the rear, and leaving the head of the shot to wobble about, can never give uniformly good results, as the great number of devices of that character brought forward and used in our recent war fully proved.

Of the two guns above named, that of Armstrong requires an expensively-made shot, which, from the moment of its manufacture until it is fired from the gun, must be guarded from injury with the greatest care. This is a highly objectionable feature, greatly detrimental to its usefulness in actual service.

The shot of Whitworth, on the contrary, may be of the simplest casting, like the round shot used in the smooth-bore; and having windage, it may get rusty or bruised in the vicissitudes of careless transportation and storage without special interference with its efficiency as a shot.

In a gun like the one proposed, where it is necessary that there shall be a gas-check between the breech and pocket charges until all the pockets are passed, this can be provided by using a wad, which is a much cheaper and more convenient method than fitting the shot to close the windage.

Whitworth's system of rifling is, however, very defective when considered in relation to the gun.

When a smooth-bore gun is fired, the entire periphery of metal around the bore is expanded with the strain. The circumference is not only enlarged in every part, but each particle of metal has been moved radially away from the center. In the smooth-bore, this movement being uniform throughout the circumference, there is no disturbance in the relations between the particles, and the metal resists the strain under the most favorable possible circumstances. When, however, the gun is rifled, in any manner whatever, this uniformity of strain and movement among the particles is destroyed, and unless the bottoms of the riflings are sufficiently extended circumfer-

entially to allow of some flexibility, the metal is strained to great disadvantage at the junction between the riflings and the lands, and will rupture with comparatively small strains. In the Whitworth system, the bottoms of the riflings (at the angles of the hexagon) are very narrow, resembling the notch which mechanics are in the habit of cutting in a bar preparatory to easily breaking it.

To obtain, then, the advantages which the Whitworth system confers upon the shot, and avoid its weakening effects upon the gun, it is necessary to have at least three inclined surfaces to bear upon the periphery of the body of the shot, forcing it to the center and causing it to revolve around its own longitudinal center of gravity, (three being the least number which will accomplish this,) and at the same time to make the bottoms of the riflings, between these inclined surfaces, carefully circumferential, and as extensive as possible.

By referring to the accompanying drawing of the gun I propose, an examination of the full-size section of the bore will show the form to which these considerations lead. The metal at the bottom of the riflings has so much circumferential length, and runs into the lands by curves of such large radius, (one-third the radius of bore,) that, when under strain and enlargement, the particles adjust themselves easily to their new position, and, consequently, withstand the strain with the same strength as in the smooth-bore gun.

It will thus be perceived that the added force necessary to give high velocity to an elongated shot being applied without adding to the strain upon the gun, and the rifling being of such a character that the gun is not weakened by it, cast iron is used for this with the same propriety as for the ordinary smooth-bore.

The shot is cast with grooves corresponding with the lands of the rifling, and requires no tool-finishing. As it has been found that chilled cast iron will penetrate armor-plates as well as steel, the adoption of this system carries us back to the economy of manufacture, transportation, and storage of the old-fashioned round shot.

The 6-inch gun, to which reference has been made as now ready for trial at Reading, Pennsylvania, is rifled in this manner. It has been fired thirteen times, and the wearing-surfaces of the lands, though commencing to polish, still show the tool-marks, the polishing being due to the sand in the carelessly-cleaned grooves of the shot.

OF THE BREECH-LOADING ARRANGEMENT.

The breech-loading arrangements which have heretofore been applied to cannon have generally had something to be removed to get the gun open, or something to get cemented with the *débris* of the burned powder so as to permanently close the gun, or at least cause delay and trouble.

In the arrangement applied to the gun proposed these objectionable features do not appear. Leakage of gas is entirely prevented by the angled ring of copper secured to the breech-plug. (See drawing.) The fact that it is heated at the same time that it is pressed out to the periphery of the bore makes it loose when it is desired to move it, because it contracts as it cools again and is quite loose. I state these facts as from my own personal experience.

With this dependence for a gas-check it is not necessary to screw the plug tight against anything; and it will be observed that the home position of the breech-cap is determined by a stop-bolt, on its forward end, coming in contact with a boss cast upon the gun. The breech-screw is therefore always loose and free to be moved.

The breech-plug is a pendulum suspended to a bolt near the periphery of the breech-cap; and the whole is so arranged that if, from the position shown in the drawing, which shows the breech closed, the cap is unscrewed until the bolt is vertically over the center line of bore, the face of the plug will have been withdrawn longitudinally from the bore and free to swing to the left in the rear of the gun as the cap is continued to be unscrewed. A recess is provided within the cap to permit the plug to swing entirely away from the bore, a stop-bolt coming in contact with the boss on the gun preventing any further movement.

The center of the cap being bored to correspond with the gun, there is free access at once.

An inspection of the drawing will show that I have provided holes extending from the periphery radially into the cap. These are for the insertion of iron bars by which the cap may be turned. With the use of bars three feet long, four men will readily screw and unscrew it.

The caps of the pocket-loading holes are arranged in the same manner, except that, as the pendulums are in nearly horizontal positions, they are thrown to one side, at the proper time, by coming in contact with stops projecting up from the gun, instead of by gravity, as in the breech-arrangement.

OF THE OUTSIDE DIAMETER OF THE GUN.

It is one of the maxims of engineering that, in every structure and machine, there

shall be material enough to meet with certainty and safety all the strains upon it during its use and no more.

When the material is of such a character that its strength in the used structure may differ widely from the specimens tested, or when the strains are not known with certainty, then large co-efficients of safety are employed; but where the material may be relied upon to differ but slightly in its tenacity from that attributed to it, and where the strains to be brought are also known to be within very narrow limits, the co-efficient of safety is reduced accordingly. In the case of guns made of cast iron, our ordnance officers have brought into practice a system of careful selection and mixture of ores, and a uniformity and care in founding, that not only result in a metal of remarkable tenacity, but also in a uniformity and reliability unattainable, thus far, with wrought iron or steel.

Indeed, cast-iron guns, as now made in this country, may undoubtedly be relied upon to withstand a strain which may be named, with more propriety than almost any other engineering structure.

In addition to this, the use of the large-grain powder and the pressure-indicator, enables us to fix the strain to be brought to almost an exact amount. There is no reason, therefore, why the co-efficient of safety should not be reduced to a minimum, the more especially as the great weight which the gun will even then have is a serious drawback to its usefulness.

I am aware that weight has been regarded as necessary in a gun, to enable it to recoil steadily when fired, and to not recoil too far. With a gun, however, which is to throw a 600-pound shot, at a velocity of 2,250 feet per second, no practicable amount of dead weight in the gun is going to accomplish this end. Dependence must be placed upon other means entirely to accomplish this; and therefore the amount of metal provided must be in accordance with considerations of strength alone.

In Rodman's report of his experiments, page 192, he states that open-ended cylinders, having a thickness of three-fourths the caliber, and a tenacity in the testing-machine of 26,866 pounds per square inch of section of the metal, were burst with a pressure of 63,384 pounds per square inch.

There being no difficulty in securing equal tenacity in every part of the gun proposed, it may be safely assumed that it would require that pressure per square inch to burst it, with a thickness of metal equal to three-fourths the caliber, and as we are never to exceed 30,000 pounds per square inch, we have, with that thickness, under the circumstances, a sufficient margin for absolute safety. I have, therefore, adopted it in the design presented, and have proportioned the pockets and their attachment to the barrel so that they will have equal strength. At the breech I have arranged for the insertion of the plug 3 inches; and for one caliber in length I have added one inch to the thickness of the barrel, beside the thread of the breech-screw, in order that the end might be as strong as other parts of the barrel. These precautions probably add strength enough to render 75,000 pounds per square inch necessary to burst the gun.

The cylinders burst by Rodman were of uniform diameter on the outside, and the pressure within was exerted quite the whole length of the bore.

OF THE LENGTH OF THE GUN.

The remaining propelling force upon the shot on its arrival at the muzzle is so much greater in the multicharge than in the ordinary single-charge gun, (see pressure diagrams,) that, to get the full advantage of the system, there should be a considerable increase in the length; and, as it is a breech-loader, this can be done without causing inconvenience in loading.

I have, therefore, made the gun somewhat larger than the usual proportion which has been given to guns of this large caliber; but I would draw attention to the fact that, formerly, when the serious work was performed by guns of small caliber, which could sustain comparatively heavy charges, they were made as many calibers long as this is, and that, as the caliber increased, the proportionate charge had to be reduced, or the guns would burst; and the length of the guns was reduced accordingly, there being no useful effect obtained by expanding the powder beyond a certain number of primes. By the adoption of the multicharge system we confer upon the large calibers the power to employ large charges of powder, and, naturally, we should give a proportionate length. Regard for convenience in use has, however, prevented me from giving the full length demanded by these considerations.

OF THE COST OF THE GUN.

From my experience in superintending the construction of the 6-inch gun now at Reading, I feel satisfied that I can furnish these guns for 50 cents per pound, of the finished weight, and that I can furnish a single gun for trial for 75 cents per pound, of the finished weight.

I am, very respectfully, your obedient servant,

ALBAN C. STIMERS.

Colonel R. H. K. WHITELEY, U. S. A.,

President of Board for Selection of Models for Experiments in Heavy Ordnance.

No. 64.]

141 CENTRE STREET, NEW YORK,

July 26, 1872.

SIR: Referring to my letter to you of the 19th instant, and to the conversations I have had with your board on that date and yesterday, I would respectfully state that, if the board are disposed to recommend the trial of the multicharge gun, but consider that three-fourths the caliber does not furnish sufficient strength to that part of the barrel subjected to the maximum strain, I am prepared to build a gun upon the design represented by the drawing accompanying my former letter, with a quarter caliber added to the thickness of all parts which receive the maximum strain, tapering from thence to the diameter of muzzle represented (21 inches,) the chase remaining as in the drawing submitted, in the form of the frustum of a cone. This change will, of course, add to the diameter and weight of the breech-cap. This will increase the weight of the gun from 25 tons, as given, to 39.

I estimate the cost of the experimental gun, made in this way, at 60 cents per pound, and of similar guns in the future—if a number are made—at 40 cents per pound.

It is proper to state that I am prepared to enter into contract with the Department to make the experimental gun at the prices named, and give the necessary sureties, submitting to such regulations and inspection as it may be deemed proper by the Department to stipulate, with the understanding that the contract will, in the case of the trial gun, be completed before the gun is removed from the foundry for trial.

In expressing my willingness to furnish a gun heavier than was originally proposed, I beg leave, very respectfully, to offer the opinion that the present facilities for determining the pressures exerted within the gun, taken in connection with the reliability of cast-iron guns, as now produced in this country, render it feasible to test the excellence of the multicharge principle with the lighter gun proposed. It has formed no part of my programme, as I intimated in my former letter, to load the gun at once with the full charges stated, but to employ small charges at first, and gradually increase them until the desired pressures are obtained. If, during the progress of such experiments, the gun gives indications of distress before the pressures contemplated are reached, further experiments can be continued with charges which will give safe pressures, and the value of this principle, as applied to ordnance, can be judged by intelligent officers as fully as if the gun possessed the necessary strength for the charges contemplated; subsequent guns could then be made as much heavier as should be indicated by the experiment.

On the other hand, if the experimental gun is made with the increased weight, it is probable that the guns of the future will be made correspondingly heavy, whether necessarily so or not, and the full benefit of the adoption of this principle, in case the added weight is superfluous, will not be obtained; the cardinal advantages expected from this invention being, that great results shall be secured with a small expenditure.

The foregoing are, however, simply my own individual opinions, and I beg leave to assure you that I shall bow with perfect cheerfulness to any decision upon the subject which the combined wisdom of your board may make, the more particularly as you all have facilities for correctly informing yourselves upon these matters which are ordinarily out of the reach of civilians.

I am, very respectfully, your obedient servant,

ALBAN C. STIMERS.

Colonel R. H. K. WHITELEY, U. S. A.,

President of Board of Selection of Models for Experiments in Heavy Ordnance.

H. F. MANN.

No. 1.]

PITTSBURGH, PENNSYLVANIA, July 5, 1872.

SIR: I have this day received from the Ordnance Department a printed copy of the Adjutant-General's General Order No. 57, dated June 28, 1872, informing me of the appointment, by order of the Secretary of War, of a board of officers to meet in the city of New York on the 10th instant, "for the purpose of examining such models of heavy ordnance as may be presented to it, and of designating and reporting to the Chief of Ordnance such models as may be selected for experiments under the * * * provision of the act of Congress approved June 6, 1872."

I desire to present plans and specifications of my system of breech-loading rifled ordnance, of large caliber, for the consideration of the board, but will not be able to prepare such plans and specifications in time for presentation on the day named for the meeting of the board, the 10th instant. I shall be glad of an opportunity to submit such plans and specifications as soon as I can prepare them, should the board continue in session, or afford me an opportunity to do so at an adjourned meeting.

I shall be thankful for any information in regard to the meeting of the board, and if favored will promise my best efforts to make the matter interesting.

Very respectfully, your obedient servant,

H. F. MANN.

General R. H. K. WHITELEY, *President of Ordnance Board.*

Care Colonel Silas Crispin, U. S. A. Agency, corner Houston and Greene sts., New York.

L. B. No. 1.]

ARMY BUILDING,

Corner Houston and Greene Streets, New York, July 10, 1872.

SIR: I am directed by the board on heavy ordnance to acknowledge the receipt of your letter of the 5th instant, and to state in reply that the board is now ready to receive from you, either by letter or in person, any communication you may be pleased to make respecting your plan for the construction of heavy guns.

Respectfully, sir, your obedient servant,

C. E. DUTTON,

First Lieutenant Ordnance, U. S. A., Recorder.

H. F. MANN, Esq.,
Pittsburgh, Pennsylvania.

No. 50.]

PITTSBURGH, PENNSYLVANIA, July 20, 1872.

SIR: Having been absent from home some days, I find your favor of the 10th instant on my return.

If the board on heavy ordnance will be pleased to name a day on which they will hear me upon the subject of heavy breech-loading guns, I shall be pleased to meet them in person.

Very respectfully, &c.,

H. F. MANN.

Lieutenant C. E. DUTTON,
Recorder, Corner Houston and Greene streets, New York.

L. B. No. 36.]

ARMY BUILDING, NEW YORK,

July 23, 1872.

SIR: Your letter of the 19th instant is received. In reply I am directed to state that your presence is optional, but should you choose to appear it would be better to do so immediately.

Very respectfully, sir, your obedient servant,

C. E. DUTTON,
First Lieutenant Ordnance.

H. F. MANN, Esq.,
Pittsburgh, Pennsylvania.

L. B. No. 41.]

ARMY BUILDING, NEW YORK,

July 26, 1872.

SIR: I am directed to inform you that the board on heavy cannon has adjourned to August 7, proximo, by which date it is expected that all matter for its action will be before it.

Very respectfully, sir,

C. E. DUTTON,
First Lieutenant Ordnance, Recorder.

H. F. MANN, Esq.

No. 66.]

PITTSBURGH, PENNSYLVANIA, July 30, 1872.

SIR: Referring to my personal interview on the 26th instant with the "board on heavy ordnance," in relation to furnishing a heavy breech-loading rifled gun con-

structed upon my system of breech-loading, I would submit the following as the basis of my proposition, not having had the time necessary since the receipt of a notice of your meeting to prepare full and complete drawings and specifications.

I would propose to make a 12-inch breech-loading rifled gun for the Ordnance Department for the purposes contemplated in the act of Congress approved June 6, 1872, providing "for experiments and tests of heavy rifled ordnance."

The breech-loading arrangements of this gun would be substantially the same as the 3-inch cast-steel breech-loading rifled field-gun and the 8-inch breech-loading rifle heretofore submitted to the Ordnance Department, and also as shown in the model herewith submitted.

I would not propose to use in the construction of this gun any untried metal, but would make the barrel of the best cast-iron gun-metal, cast upon the Rodman principle; the side-links, breech-transom, and smaller parts of the breech-loading arrangements of the best forged wrought iron, the breech-block of cast iron, and the screw of the best cast steel.

For the gas-checks I would use a composition similar to that used for the sabots upon the "Taylor-Dyer" rifle-projectiles, unless *papier maché* or some other material should be found by experiment to be more suitable for the purpose; but from the nature of the first-named composition, and the fact that gas-checks made of it could be, after use, easily recast, I am of the opinion that it would be preferable.

The principal dimensions of the gun would be about as follows: length of bore, 20 feet; maximum diameter, 42 inches; minimum diameter, 22 inches. The size of the different parts of the breech-loading arrangements would be made upon a basis of strength of metal sufficient to resist a powder-pressure in the bore of the gun of 100,000 pounds per square inch.

The rifling would be of a uniform twist, making one turn in 80 feet; the grooves and lands of about equal widths, the grooves having rounded corners, and to be about two-tenths of one inch deep.

I would propose, as a proper charge for this gun, 100 pounds of perforated cake or mammoth-grained powder and a projectile of 475 pounds weight; also, should it be desirable to fire from the same gun a round solid shot or shell at very high velocity, I would use a charge of 125 pounds of powder.

I would furnish the above-proposed gun, delivered at the place where made, for the sum of twenty-five thousand dollars, (\$25,000,) one-half to be paid upon the execution of the contract and the balance when the gun shall have been fired ten proof-rounds with the above-named charges of powder and weight of projectiles; provided that upon the execution of the contract, and before the payment of said one-half the price I shall furnish sufficient bond, with surety to the amount of said one-half payment, for the faithful execution of the contract.

With regard to the principle upon which my system of breech-loading is founded, the board will please bear in mind that it is such as to afford the most perfect uniformity and equality in the distribution of metal about the seat of the charge, and in all of its parts; that there is no contact of the screw and breech-loading arrangements with the charge; that no heat from the charge can be communicated to these parts, except through the solid breech-block, and that the vent being placed in this block, there can be no unequal expansion or contraction of metal in the gun, and I respectfully submit that, the pressure per square inch in the bore being given, the required size and strength of the breech-loading parts, to resist that pressure, can be as certainly determined as can be the parts of a steam-engine or other mechanical structure.

Very respectfully, your obedient servant,

H. F. MANN.

General R. H. K. WHITELEY,
President of the Board on Heavy Ordnance,
Corner Houston and Greene streets, New York.

[Telegram.]

L. B. No. 50.]

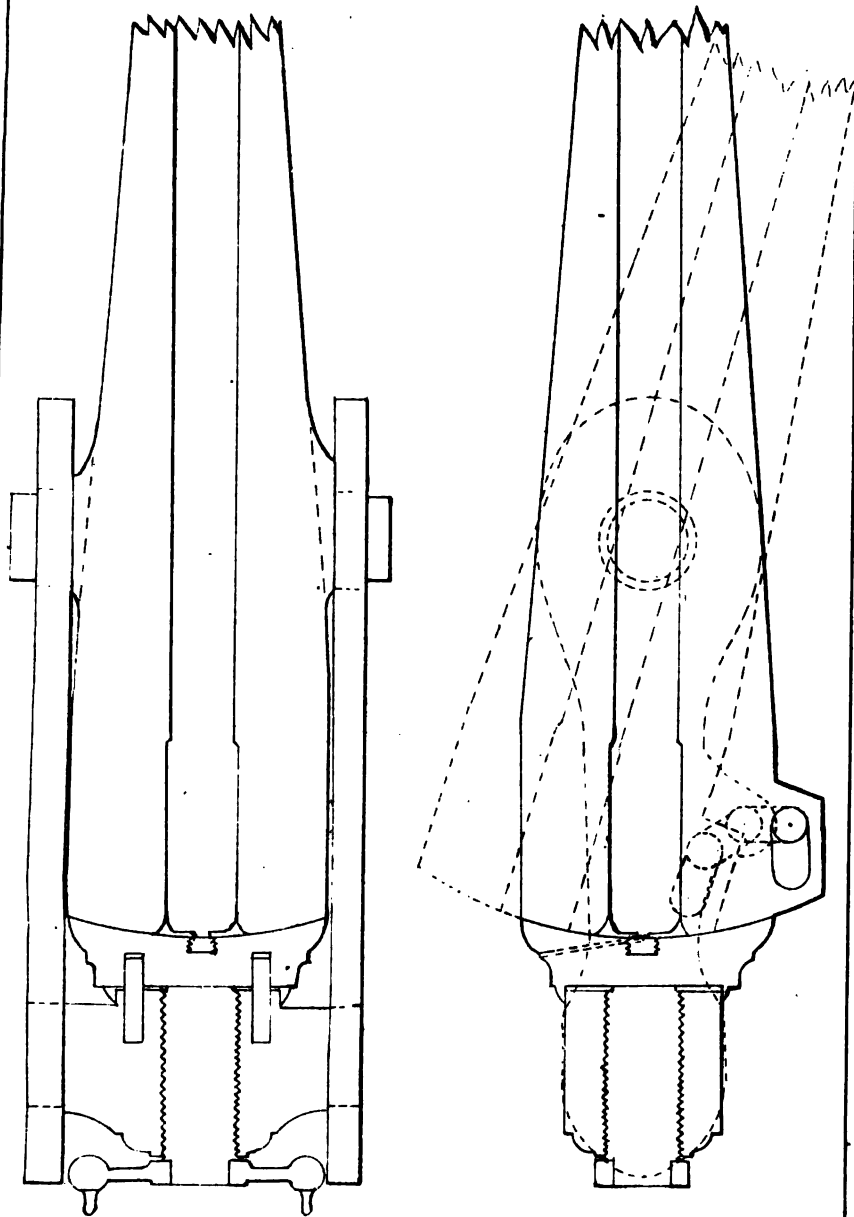
ARMY BUILDING, NEW YORK,
August 13, 1872.

General A. B. DYER, Washington, D. C.:

The board desires reports of trial of Mann's 8-inch breech-loading gun.

R. H. K. WHITELEY,
Colonel of Ordnance, President Board Heavy Ordnance.

H. F. MANN'S
12 Inch Breech Loading Rifle Gun.



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No. 90.]

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, D. C., August 13, 1872.

SIR: In compliance with request contained in your telegram of this date, please find inclosed copy of a report of trial with Mann's 8-inch breech-loading gun.

Respectfully, your obedient servant.

By order of Chief of Ordnance.

S. C. LYFORD,
Captain of Ordnance, Principal Assistant.

Colonel R. H. K. WHITELEY,
President of Board on Heavy Ordnance,
Corner Houston and Greene streets, New York City, New York.

[Inclosure.]

FORT MONROE ARSENAL, VIRGINIA,
May 1, 1865.

SIR: I have the honor to report that, in obedience to your instructions, I have fired the breech-loading gun of Mr. Maun's invention, with the projectiles furnished by him, and transmit herewith a target-record * of fire, giving in detail the results obtained. As a drawing of this gun and the projectiles fired from it has been furnished you by Mr. Mann, no description of either is necessary in this report.

The number of projectiles fired was hardly sufficient to test the merits of the gun. The main points which could be decided by this firing were the range and velocity, with a given charge and pressure, as compared with other guns of the same caliber, and whether the device for closing the breech could be worked with facility, and performed properly its office.

All the information obtained with regard to the first point is given you in the target-record.

With regard to the second, I would state that the breech was opened after firing, the gun loaded, and the breech closed without difficulty, and in about the same time and with the same number of men as would be required to load a muzzle-loading gun of the same caliber. Although gas escaped freely at the breech, the consequent fouling of the parts did not interfere at all with working them freely, and would not, I think, even should the gun be fired continuously and rapidly. In firing the gun, gas-checks were used, with a view of preventing the escape of gas at the breech. At the first fire, one of copper was used, and seemed to prevent all escape. The same gas-check was used at the second and at the last eleven fires, but failed altogether to prevent the escape. At the other seven fires, gas-checks of cast and malleable iron were used. These were broken at the discharge, and of course failed to perform their office.

A great defect in the gun is its preponderance of nearly one thousand pounds, which interferes materially with rapid maneuvers. I do not see, however, that this is at all necessary, and if other guns should be made, I presume the axis of trunnion might be thrown nearer the center of gravity. It is also questionable, I think, whether the grooves of the gun have a sufficient twist, viz., one turn in 80 feet. Most of the projectiles fired took the rifle motion well, but they were shorter and lighter than those usually fired from guns of this caliber. Their length was 13 inches and weight 118 pounds. An examination of the table of fire will show that the results obtained compare favorably, so far as range and velocity with a given charge and pressure are considered, with the results obtained with other guns.

At the close of the firing, the bore of the gun was carefully examined, and showed no signs of having been in any way injured.

I would respectfully suggest that the firing be continued to test the endurance of the gun.

Respectfully, your obedient servant,

THEO. EDSON,
Captain of Ordnance, Commanding.

Brigadier-General A. B. DYER,
Chief of Ordnance, Washington, D. C.

No. 89.]

PITTSBURGH, PENNSYLVANIA, August 13, 1872.

General R. H. K. WHITELEY,
President Board of Heavy Ordnance, Army Building, corner Houston and Greene streets:

If the board will permit me, I will appear and make further representations with regard to my 12-inch breech-loading rifle gun, on Saturday or Monday next.

H. F. MANN,
Care Jones & Laughlin.

* The detailed target-record of firing is omitted from publication.

L. B. No. 55.]

ARMY BUILDING, NEW YORK, August 13, 18

H. F. MANN,

Care Jones & Laughlin, Pittsburgh, Pennsylvania :

The board will be ready to hear you next Monday at 12 o'clock.

C. E. DUTTON, *Record*

E. R. McCABE.

No. 71.]

LEIGHTON, MAHASKA COUNTY, IOWA,

July 24, 187

SIR: Your favor of the 19th instant is only just received.

Herewith I send my patent, which contains the required specifications and drawings, which you will please present to the board. I could not get a copy made as it ought to be.

I would be anxious to know if the board could make a requisition on the Patent Office for a loan of the model of my gun, as I feel, what may seem somewhat complicated in a drawing would be found, on an inspection of the model, to be in real quite simple.

Very respectfully, your obedient servant,

E. R. McCABE, M. D.

C. E. DUTTON,

First Lieutenant, Ordnance Department.

[Inclosure.]

Edward R. McCabe's improvement in breech-loading ordnance, patented May 27, 186
No. 35380.

Be it known that I, Edward R. McCabe, of Rochester, in the county of Mahaska and State of Iowa, have invented certain new and useful improvements in breech loading ordnance, and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings forming part of this specification, in which Fig. 1 is a side view of the breech part of a cannon constructed according to my invention; Fig. 2 is a longitudinal central vertical section of the same; Fig. 3 is a transverse section of the same taken immediately in front of and looking toward the breech.

Similar letters of reference indicate corresponding parts in the several figures.

The principal object of my invention is to obtain a gun in which gun-cotton may be used, and which will therefore be particularly serviceable in casemates and between the decks of ships, as the use of gun-cotton, owing to the little smoke produced, does not produce in the men working the gun in a confined place the choking thirst, smothering sensation, or blindness caused by using gunpowder. Owing to the danger of loading at the muzzle with gun-cotton, I employ the breech-loading system, and my improvements are more particularly directed to the strengthening of the breech and its connections, and the surrounding parts, to produce a breech-loading gun of the requisite strength.

The first improvement consists in fitting the chamber of a breech-loading cannon with a stout tube of steel or other tenacious metal, which I call an internal re-enforce, the interior of which is much smaller than the caliber of the gun, and the length of which is sufficient to enable it to contain the charge, the object of the said tube being both to strengthen the gun and to reduce the amount of the area of the breech that is exposed to the force of the explosion. The second improvement consists in a novel mode of locking and tightening up the breech, whereby the joint between it and the chamber is made very secure and close. A third improvement consists in a novel priming and firing apparatus.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and operation.

The gun A should be made very stout at the breech. It is bored right through, and counter-bored a little larger for a sufficient distance from the rear for the reception of the internal re-enforce B, which, when inserted as far as it will go, has its rear end flush with the rear end of the gun, which is faced perfectly true and flat and perpendicular to the axis of the bore. The interior of the re-enforce B is cylindrical, and its caliber may be about half of that of the regular bore of the gun. Its front end may be flat, or of other form, according to the form of the projectile used, the latter being arranged close in front of it, as shown in outline in Fig. 2. If made of steel this re-enforce will add very greatly to the strength of the gun. The charge is to be inserted in the interior of the re-enforce B, in a cartridge of thin metal, and is intended to fill up its

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interior. Two or more of these re-enforces may be used and changed after one or more discharges, to allow them to cool. The one in the gun is always withdrawn for loading, as otherwise the projectile could not be inserted at the breech.

The withdrawal is effected by an elastic hooked fork, which may be compressed to allow it to pass through in a forward direction far enough for the hooks to spring in front of the re-enforce. By removing the re-enforce the gun is enabled to be used like ordinary guns for gunpowder.

The breech is composed principally of two very stout plates or blocks, C D, of metal, arranged one behind the other, and connected by screws *a a*, in such manner as to permit them a slight movement toward and from each other. These screws are merely to hold the two plates or blocks together. The front plate or block C has screwed into it, or otherwise rigidly attached to it, a socket, E, which passes through the center of the plate or block D, surrounded by a hollow screw, G, which is screwed through the latter plate or block from the rear. The plate or block C is attached at the bottom by a hinge-joint, *b*, to the bottom part of the rear end of the gun, so that the breech may open by swinging backward and downward. To each side of the gun, at a short distance from the rear end, there is secured by a hinge-joint, *f*, one of two dovetail cheek-pieces F F, of steel or wrought iron. These cheek-pieces have each three dovetails, *c*, *d*, and *e*, two having the same direction, and fitted to separate dovetail recesses in the corresponding side of the plates or blocks C and D, and the third, *e*, fitted to a dovetail recess in the corresponding side of the portion of the gun in rear of the hinge-joint *f*. This arrangement of the dovetails of the cheek-pieces causes them to lock the breech to the gun independently of the hinges *f*, which are only to attach the cheek-pieces to the gun in a suitable manner to have them always in the proper position. The screw G screws up against the front plate or block C, to set it up tight against the rear end of the gun after the breech has been secured by the cheek-pieces, which have their dovetails, *c d*, fitted very easily into the plates or blocks C D. To open the breech, the screw G is first turned back about one-fourth of a revolution, to loosen the cheek-pieces in the plates or blocks C D. The cheek-pieces are then swung aside, and the breech thus allowed to drop down. To close and lock the breech, it is first raised up to the rear of the gun; the cheek-pieces are then brought into the dovetail cavities in its sides, and the screw G is then screwed up tightly against the plate or block C, thus tending to separate the plates or blocks C and D, and bring C close up to the rear of the gun, and D back hard against the dovetail *d d*. The object of making the breech of the two plates or blocks C D, and applying the screw G, is to afford facility for opening it easily, and to enable it to be made very tight when closed and secured.

The socket E is for the reception of the priming-tube H, which is fitted to work easily back and forth within it, a shoulder, *g*, being provided in the socket, and a corresponding shoulder on the tube, to prevent the latter from entering too far. The front end of the tube H is closed, except that there are vents *i i* to permit the passage of the fire of the priming to the charge, and it is made with a point, *h*, to penetrate the cartridge for the fire to enter. Some distance from the closed front end there is an opening, *n*, in one side of the tube, for the admission of pellets of percussion-priming. The tube H is furnished near its front end with a spring-catch, *j*, to retain it in the socket by entering a groove, *k*, provided in the latter, but this spring is constructed and arranged to be liberated from the socket by pressing it with the thumb or finger. I is a plunger working in the priming-tube H, for the purpose of exploding the priming, and attached to the tube by a slot, *l*, and pin *m*, or other means that will allow it to move back and forth some distance within the tube. The plunger has at its outer end a knob by which to take hold of it, and withdraw it and the tube from the breech. I will here remark that the drawing represents the priming-apparatus very much larger relatively to the gun than it would require to be in practice. To apply the priming, the knob of the plunger I is taken hold of and the spring *j* pressed with the thumb or finger, and both the plunger and the priming-tube are withdrawn together from the breech. A pellet of priming is then dropped into the tube in front of the plunger through the hole *n*, and the tube and plunger are replaced in the socket. To fire, the head of the plunger is struck sharply with a mallet or hammer, and the plunger and tube thus driven forward together, making the point of the tube penetrate the cartridge, and causing the priming to be exploded between the end of the plunger and the front of the cavity of the tube.

I do not claim broadly fitting the chamber of a breech-loading gun with a tube, as I am aware that a light tube had been used therein to obtain convenience in loading, without adding to the strength of the gun, but, on the contrary, its interior being of the full size of the bore of the gun. Neither do I claim broadly the reduction of the size of the chamber, as that is done in muzzle-loading guns.

But what I claim as my invention, and desire to secure by letters-patent, is—

1st. Fitting the chamber of a breech-loading gun with a removable tube B, of the character herein described, and termed an internal re-enforce, for the purpose specified.

2d. The breech composed of two plates or blocks C D, combined with each other

and with the gun by means of the dovetail cheek-pieces F F and screw G, applied and operating substantially as and for the purpose herein specified.

3d. The priming-tube H and plunger I, applied in combination with each other and with the breech, substantially as herein specified.

EDWARD R. McCABE.

No. 72.]

LEIGHTON, MAHASKA COUNTY, IOWA,
August 1, 1872.

GENTLEMEN: I know that many are opposed to gun-cotton on account of its quickness, and hence greater danger of bursting a gun.

That such may be the case in ordinary guns is very likely; the more so that the greater the bulk of metal the more likely to be porous, or loose-fibered in the center. But, with my re-enforce of tough hammered iron, or steel, with the gun of much lighter metal, I would have no fear.

However, if you should prefer an initial or gradual force, I offer a plan for such in Fig. 4 of the plate inclosed.

It is simply to divide the cartridge into unequal parts, by a wad, or by metal the same as the case is composed of, which will offer a momentary resistance to the burning of the mean charge, marked letter A on the plate. The percussion-powder at B is struck, as is described on the plate by the plunger through the breech. You see the intention is to fire it in front instead of rear.

Fig. 5 is to show a hollow in the base of the projectile, with the cartridge projecting beyond the re-enforce into it, so as to give an even center below, and also to prevent windage, so that little or none of the force of the charge is wasted.

I send by this mail a model, which, although roughly made, will, I think, show my plan better than drawings.

You will see that there is great advantage in breech-loaders, from the fact that when opened there is a free draught of air, which, in connection with the re-enforce, which can be changed at every shot, must keep the gun cool. Moreover, when they have not to be run in and out of port-holes, will they not require fewer hands to work them?

One great advantage in my plan of breech is, it is easily kept clean, and there can be no jam, as in the "Armstrong gun," which has a long screw which has to be screwed in and out, and likely to jam from the heating of the gun and the powder getting between the male and female screw.

The band on the muzzle of the model I propose to prevent vibration, which, after continued firing, may change the nature of the metal from fibrous to a crystalline state, and hence make it brittle. The band may be of India-rubber, or any other non-metallic substance.

Some scientific men say that continued hammering, by causing vibration, will do so; hence I think that firing will have the same effect, and it may be one cause why guns burst very often in the upper half.

There is another reason why a breech-loader is preferable. You can see through the bore, and consequently can more easily detect flaws and imperfections in rifling, &c., whereas, in the muzzle-loader, you can only examine by reflected light.

Very respectfully, your obedient servant,

E. R. McCABE, M. D.

The BOARD ON HEAVY CANNON.

No. 85.]

LEIGHTON, MAHASKA COUNTY, IOWA,
August 8, 1872.

GENTLEMEN: I should mention that the sides of the dovetails of the cheek-pieces, when they fit into the sides of the screw-plate, can be beveled, as also the sides of the screw-plate, so that when the screw is tightened, or screwed up against the breech-plate, that action draws the screw-plate back, so that it locks with the bevel of the dovetails, and so prevents the cheeks from opening until the screw is relaxed.

This is intended merely as an additional precaution, as I think the pull of the screw-plate on the cheek-pieces, by the action of the screw, quite sufficient to keep them from opening.

But if deemed necessary they could shut with spring-snaps, which would be easily manipulated.

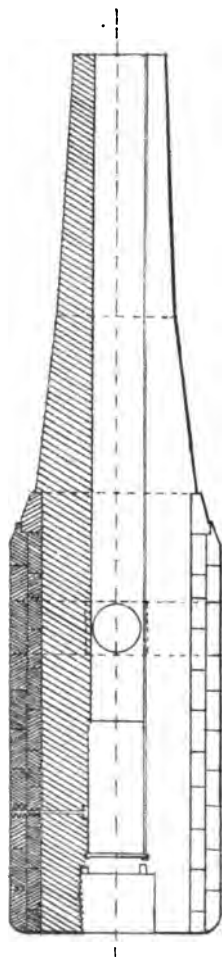
Very respectfully, your obedient servant,

E. R. McCABE, M. D.

The BOARD ON HEAVY CANNON.

P. S.—Will you please inform me if the patent-right and model have been received?

*SKETCH showing the RINGING
or FRETTING of
FRENCH & SWEDISH CAST-IRON
RIFLES.*



The ferreture is not shown in this sketch.

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L. B. No. 48.]

ARMY BUILDING, NEW YORK, August 12, 1872.

SIR: I have the honor to inform you that your letters have been received and laid before the board on heavy cannon. Your letters-patent and the model referred to have also been received.

Very respectfully, sir, your obedient servant,

C. E. DUTTON,

First Lieutenant of Ordnance, Recorder.

Dr. E. R. McCABE,
Leighton, Iowa.

LIEUTENANT O. E. MICHAELIS.

No. 37.]

WATERTOWN ARSENAL, MASSACHUSETTS,

July 17, 1872.

SIR: In accordance with the invitation extended in General Orders No. 57, Adjutant-General's Office, current series, I take the liberty of addressing this communication to the board of which you are president. Should the board deem it advisable to recommend further trials with cast iron as a material for the construction of heavy rifled ordnance, I would respectfully suggest that we avail ourselves of the experience of Sweden and France in this direction. Both these countries have used cast-iron muzzle and breech loading rifles for years, and their guns have exhibited an endurance that may be deemed satisfactory, if we consider the uncertain nature of the material used in their fabrication. I append for the information of the board, though probably they are already before it, some data concerning the performances of French and Swedish guns. Both states have adopted the Rodman plan of casting, though Sweden has introduced two important modifications, both foreseen by General Rodman, but never, I believe, applied in this country.

First. The flask is surrounded by a very thick layer of sand for the purpose of retarding outward radiation, (thus replacing the Rodman "pit-fire";) and

Second. The casting is cooled by a current of air, which begins its flow simultaneously with the metals.

After the expiration of about thirty hours the core is withdrawn, and a stream of water is substituted for the air-current to complete the cooling. This is in brief the method followed at the Finspong foundry, where some of the best European cast-iron rifled tubes have been fabricated. Both the French and Swedish guns are furnished with two layers of steel rings (*frettes*) shrunk on, which produce a sensible diminution in the diameter of the bore, varying from 0".003 to 0".007, according to the tension of the rings. As a rule the cast-iron tube is about one caliber thick under the rings, and these are one-half or one-quarter caliber thick, according as one or two series are applied. Lieutenant Gadaud, of the French navy, in his "*L'artillerie de la marine française*," gives the following figures for the proper "shrinkage" dimensions of the rings:

		Caliber, 6". 48.	Caliber, 7". 64.	Caliber, 9". 45.
		One layer.	Two layers.	Two layers.
Difference in diameter.....	{ First layer .. Second layer.	0". 035	0". 027 0". 035	0". 043 0". 046

I join with this letter a rough sketch showing the disposition of the rings or "*frettes*." The cost of the French 274.4 millimeters (about 11 inches) breech-loader is about \$4,500, gold.

It seems to me that it would be worth while, provided cast iron is not entirely superseded as a material for the construction of rifled ordnance, to construct a gun on the Swedish plan, ringed or "*fretted*" with Krupp, Bessemer, or other steel, or perhaps with the homogeneous metal obtained by the Martin-Siemens process.

I have the honor to remain, very respectfully, &c.,

O. E. MICHAELIS,

First Lieutenant Ordnance Corps.

General R. H. K. WHITELEY, New York.

No. 90.]

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, D. C., August 13, 1872.

SIR: In compliance with request contained in your telegram of this date, please find inclosed copy of a report of trial with Mann's 8-inch breech-loading gun.

Respectfully, your obedient servant.

By order of Chief of Ordnance.

S. C. LYFORD,
Captain of Ordnance, Principal Assistant.

Colonel R. H. K. WHITELEY,
President of Board on Heavy Ordnance,
Corner Houston and Greene streets, New York City, New York.

[Inclosure.]

FORT MONROE ARSENAL, VIRGINIA,
May 1, 1865.

SIR: I have the honor to report that, in obedience to your instructions, I have fired the breech-loading gun of Mr. Mann's invention, with the projectiles furnished by him, and transmit herewith a target-record * of fire, giving in detail the results obtained. As a drawing of this gun and the projectiles fired from it has been furnished you by Mr. Mann, no description of either is necessary in this report.

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Respectfully, your obedient servant,

THEO. EDSON,
Captain of Ordnance, Commanding.

Brigadier-General A. B. DYER,
Chief of Ordnance, Washington, D. C.

No. 89.]

PITTSBURGH, PENNSYLVANIA, August 13, 1872.

General R. H. K. WHITELEY,

President Board of Heavy Ordnance, Army Building, corner Houston and Greene streets:

If the board will permit me, I will appear and make further representations with regard to my 12-inch breech-loading rifle gun, on Saturday or Monday next.

H. F. MANN,
Care Jones & Laughlin.

* The detailed target-record of firing is omitted from publication.

E. R. M^Y CABE'S
Improvements in Breech-loading Ordnance.

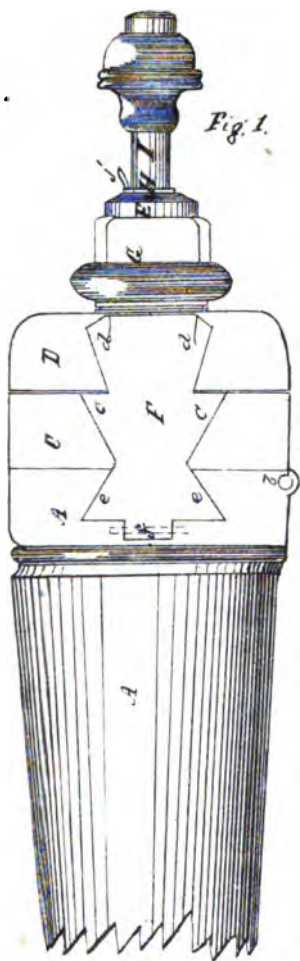


Fig. 1.

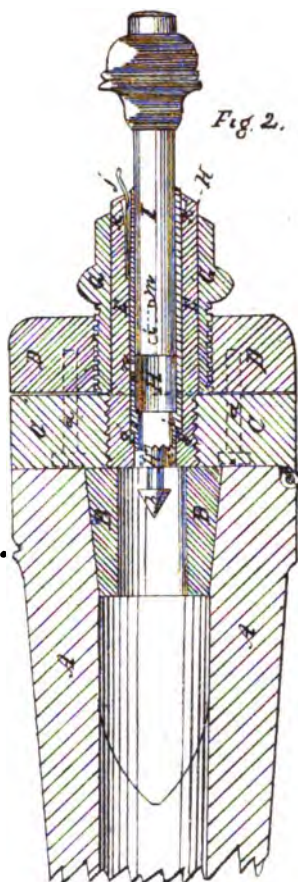


Fig. 2.

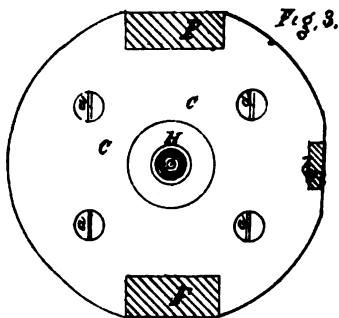


Fig. 3.

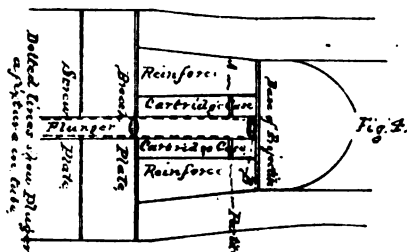


Fig. 4.

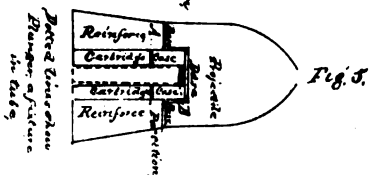


Fig. 5.

L. S. PARKER.

No. 75.]

LOCKPORT, July 25, 1872.

STATE OF ILLINOIS, Will County :

To the honorable board on heavy ordnance now in session in New York City :

GENTS: Please find herewith letters-patent for breech-loading ordnance, which, by instructions from Adjutant-General Townsend and S. V. Benét, major of ordnance, I am requested to bring this invention before your honorable body. I have a model in iron and brass which, if required, can be sent you by express. You will please give the invention such an examination and test as will satisfy you of its merits; and if the model is wanted by your honorable board, please direct where to forward it and I will send at once. You will please return the inclosed letters-patent, after getting done with them, to me.

Respectfully, your obedient servant,

L. S. PARKER.

[Inclosure.]

[No. 75.]

L. M. Lull and James T. Starr's improvement in breech-loading cannon, patented February 18, 1868, No. 74,557.

Be it known that we, Lucius M. Lull and James T. Starr, of Walnut Grove, in the county of Knox, and in the State of Illinois, have invented certain new and useful improvements in breech-loading cannon, and do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings and the letters of reference marked thereon, making a part of this specification.

In the annexed drawings, A represents a cannon, constructed of the usual materials, and provided with an oblong-shaped breech in the rear end. Within this breech is placed a cylinder, B, which lies upon the bed at the bottom of the breech, and connected to the cannon by means of trunnions, *b b*, which fit into L-shaped grooves on each side of the breech. This cylinder is made rounding at its lower side and at its end, to correspond with the shape of the bed, which is slightly cut out at the rear (as shown at *c*, Fig. 1) for the rear end of the cylinder when in a vertical position.

The rear end of the cannon-bore has a shoulder formed around it, so as to secure the collar *z*, made on the front end of the cylinder B, and secure it in its place.

D represents a lever, which is pivoted in a vertical slot (at *y*) in the rear end of the cannon, and which is connected to the cylinder by a chain, C, with a hook, so that it can readily be detached from the gun. This lever has a shoulder, *x*, upon its forward face, which fits over a corresponding shoulder on the upper rear end of the cylinder B.

E represents a horizontal bar, pivoted at one side of the gun, in the rear of the lever, and is intended to lie upon the cannon in the rear of the lever, for holding upon the shoulder of the cylinder. This bar has a metal loop, *a*, at its outer end, for tying or chaining the said bar to the ground or carriage.

It will be seen that when the lever D is in a vertical position the cylinder is held in its place by the collar *z*, under the cannon-bore, and the shoulder *x*, upon the lever, so that there is but little danger of the cylinder being thrown from its place by the concussion.

In loading the gun, the bar E is thrown from behind the lever, and the lever drawn to the rear, carrying the cylinder with it by the chain C. There may be a small roller, *o*, placed underneath this cylinder for facilitating its movement for loading. The cartridge is placed within the cylinder when in the position, as shown in the dotted lines in Fig. 1, and the cylinder then thrown down and forced into position.

By this invention, there is no danger from premature discharges, and the gun can be made inoperative should it be in use when retreating. By withdrawing the lever D and bar E the cannon cannot be used, while the two said parts can be easily carried off by the persons retreating.

Having thus fully described our invention, what we claim as new, and desire to secure by letters-patent, is—

The breech-block or cylinder B, constructed as herein described, and used in combination with a cannon, provided with lever D, chain C, and bar E, when constructed in the manner substantially as and for the purposes specified.

In testimony that we claim the foregoing, we have hereunto set our hands, this 6th day of April, 1867.

LUCIUS M. LULL.
JAMES T. STARR.

No. 24557

L.M.Lull & J.T.Starr

Breech Loading Cannon

Fig. 2.

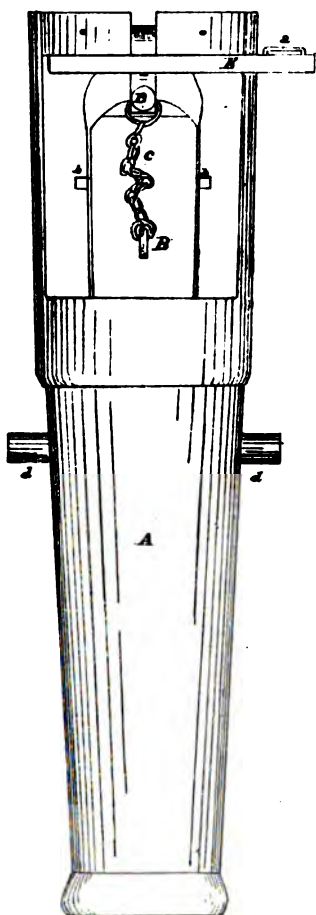
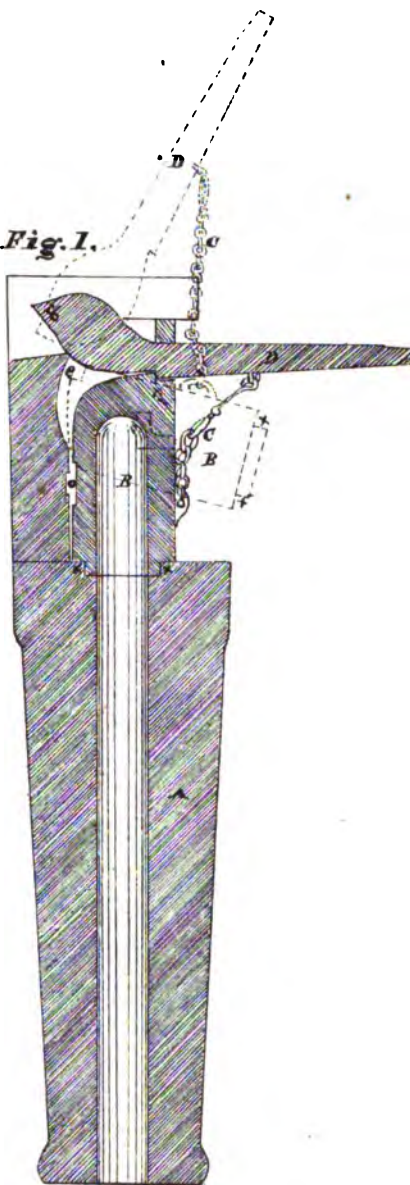


Fig. 1.



A. F. POTTER.

No. 80.]

410 KEARNEY STREET, SAN FRANCISCO,
July 17, 1872.

SIR: I learn by the papers of an appropriation for testing breech and muzzle loading heavy ordnance models, to be selected by yourself, and, as the agent of Mr. A. F. Potter, the inventor, I offer for your consideration and examination Potter's breech-loading needle-cannon, and ask for it a place in the proposed competition. There are two patents now existing on the Potter gun, and further improvements have been made in each since their issue.

I inclose the Scientific Press newspaper of November 5, 1870, (published in San Francisco, California, Vol. xxi, number 19,) which contains an illustration of Mr. Potter's gun, the drawings showing some of the later improvements. It also has a somewhat careful description of the gun and its parts.

The gun, from which the illustration in the paper was drawn, is a piece of about 4 pounds caliber, smooth-bore dimensions. It has been fired many hundred times, both shotted and with blank cartridges, without injury or accident. The firing was done partly by Mr. Potter, partly by myself, and by the Republican club of the city of Vallejo, in this State. It has been in use as a salute-gun on all public occasions since November, 1870.

In any communications with me, (if desired,) please address me at the street and number given in the heading of this letter.

Respectfully,

SAML. L. CUTLER.

The Hon. SECRETARY OF WAR,
Washington, D. C.

[Indorsement.]

ORDNANCE-OFFICE, July 27, 1872.

Respectfully referred to the board on heavy ordnance, and the writer so informed.
By order of the Chief of Ordnance.

S. C. LYFORD,
Captain of Ordnance, Principal Assistant to Chief of Ordnance.

[Inclosure.]

[Extract from the Scientific Press of November 5, 1870.]

There has been on exhibition in the Merchants' Exchange, in this city, for some weeks past, a breech-loading cannon, which has been examined by a large number of scientific and military men, and which would certainly appear a most effective weapon. A full description of this gun, for which patents have been obtained through the Scientific Press Patent Agency, has already appeared in our columns; but so much attention has been paid to it of late, and so much said in praise of its merits, that we think it well worth illustrating at this time.

This gun is a breech-loading needle-cannon, with a most ingenious elevating and depressing apparatus and automatic scale. It is constructed in three general parts: The barrel, which needs no further comment; the ring A; and the breech-pin B. The ring is of the general form and construction shown in the cut, and screws into the rear of the barrel. Into this fits the breech-pin, which is firmly locked in place by means of keys, *a*, (having a cam motion,) which play in corresponding grooves, *b*, in the ring, being actuated by means of the lever C. In loading the breech-pin is removed, the cartridge inserted into the bore, the pin replaced, and the keys made to project into the grooves of the ring. The hollow needle *d* projects into the center of the cartridge, which is fired (through the vent which extends through the breech-pin and needle) by a common friction-primer.

By this construction several important advantages are gained. The gun unites firmness with simplicity in the fastenings of the several parts, and can be worked with less men and fired more rapidly than any other which has come under our notice. And then all that is required to disable the gun is to remove the breech-pin, a most simple and effectual method.

The main difficulty in the successful working of breech-loading cannon has been found to consist in the expansion of the parts by the heat which is necessarily evolved from rapid firing, the fouling of the gun, and the escape of gases. These difficulties are obviated in this invention by making the breech in two parts, so arranged that the expansion of the one neutralizes the effect of the other. It is supplied with a

packing of felt and rubber, and a movable face-ring of steel, which render the escape of gases impossible; for the greater the pressure, the closer the joint is packed.

The elevating and depressing apparatus, and the automatic scale, render entirely unnecessary the use of a quadrant in taking elevations, and, at the same time, the gunner will not be so liable to make mistakes as heretofore by the old method. It may be briefly described as follows: Under the barrel of the gun are two eccentrics, *e*, on the transverse shafts, which are turned by means of a horizontal shaft, *f*, and worm-gear, shown more fully at *C*. This shaft is provided with a hand-wheel, and attached to it is an indicator, which passes over an index-plate, *g*, with degrees marked upon it which correspond with the arc of the barrel. In the cannon which have the breech cast on the barrel, there is a vibration, on firing, of the latter part, which does not extend to the former, just as in the case of a tuning-fork. Now, at the point at or near the breech, where the vibration ceases, crystallization of the metal is apt to occur, and, of course, the piece becomes worthless. By this construction the vibration takes place throughout the whole gun, and the crystallization is obviated.

The patentee of the cannon here illustrated is Mr. Abiath F. Potter, of Oakland, who has spent years in studying the subject of gunnery, and who has made several important inventions relating to the subject, as his improved projectile, &c.

No. 94.]

410 KEARNEY STREET, SAN FRANCISCO, CALIFORNIA,

August 9, 1872.

SIR: On the 17th ultimo I addressed the Hon. Secretary of War, offering Potter's breech-loading needle-cannon and improvements for competition, &c., as stated in my said letter. I also inclosed with the letter of the 17th a copy of the Scientific Press Newspaper of this city of date November 5, 1870, (Vol. xxi, No. 19,) containing drawings and description of the gun and improvements.

I have just received communication from the Ordnance Office, War Department, bearing date July 27, (or 21,) 1872, stating that my communication of the 17th ultimo first above mentioned had been sent to your board on heavy ordnance sitting in New York City, and referring me to the board "in continuation of the said subject," and directing me to address you as above.

I will therefore specially call your attention, and through you the attention of your said board, to my letter of the 17th ultimo, and the paper inclosed therewith, and especially to the inventions of Mr. Potter mentioned and described in said letter and paper, and repeat the request of my first letter for a place for said inventions in the competition proposed and the testing to be made of breech and muzzle loading heavy ordnance models.

Mr. Potter has two small guns made after his plans, one at the East of about 1 pound caliber (round shot,) and another on this coast, of about 4 pounds caliber round shot, and both smooth-bore. Mr. Potter's improvements in artillery are:

1. A breech-loading needle-cannon.
2. An automatic registering apparatus for adjusting elevation and depression of guns, adapted to all sizes of artillery.
3. A pointed shot for smooth-bore guns.

As we are here profoundly ignorant of what your board is doing or has done in the premises, I will ask that you send me, as early as may be convenient, such instructions, &c., as may enable me to put the inventions above named properly before your board for testing examination, and your decision as to their merits, or the merits of any of them.

The gun has been tested practically to the amount and in the manner stated in my letter of the 17th ultimo, to which I again refer your honorable board on this subject.

The elevating and depressing apparatus does away with the use of instruments in adjusting elevation, &c., to degrees, and is compact, and not liable to any injury in action that would not destroy the gun-carriage itself.

The conical shot for smooth-bore guns we have tried with considerable and gratifying success from balls from three-fourths inch diameter of bore up to balls for a 6-pound English smooth-bore field-piece, and the successes made show that Mr. Potter's plan would be well worth the attention and experiments of the Government.

In all matters please address me at my office as given in the superscription hereof.

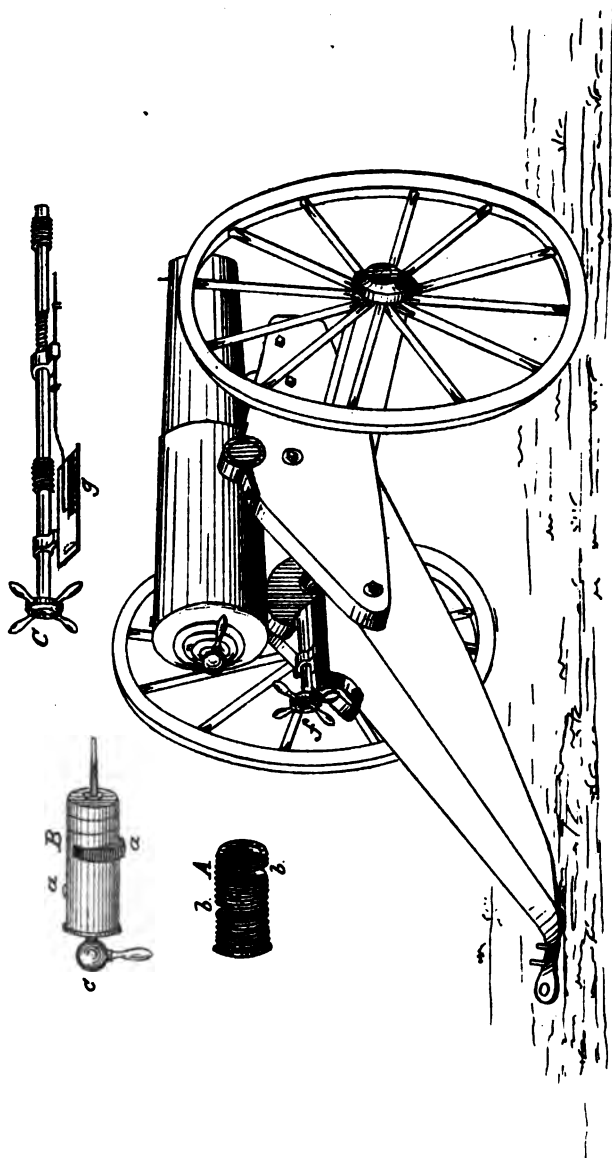
Respectfully, your obedient servant,

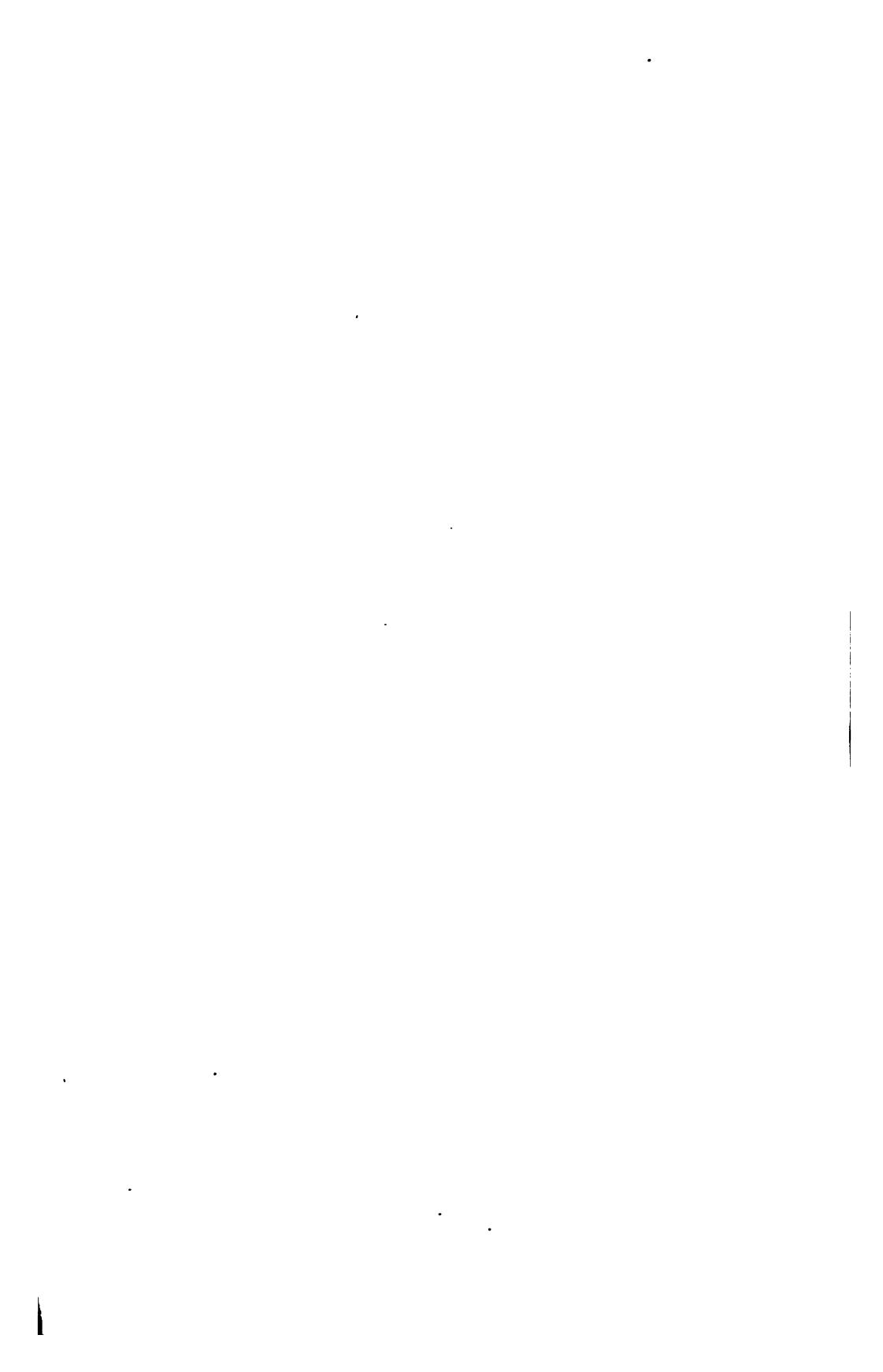
SAML. L. CUTLER.

General R. H. K. WHITLEY,

President Board on Heavy Ordnance, New York City.

POTTER'S Breech Loading NEEDLE CANNON.





JACOB REESE.

No. 28.]

FORT PITT IRON AND STEEL WORKS,
 REESE, GRAFF & Co.,
Pittsburgh, Pennsylvania, July 6, 1872.

DEAR SIR: I have your circular dated June 28, 1872, and regret that pressing duties at home will prevent me from meeting the board in New York, July 10.

Herewith I hand you a brief description of my plan and process of making heavy cannon, which I shall be pleased to have you place in their hands, and if considered worthy of their attention, I shall be at their service on short notice.

Yours, truly,

JACOB REESE.

E. D. TOWNSEND,
Adjutant-General United States War Department, Washington, D. C.

[First indorsement.]

ADJUTANT-GENERAL'S OFFICE,
Washington, July 11, 1872.

Respectfully referred to the Chief of Ordnance, for proper action. The writer has been informed of this reference.

E. D. TOWNSEND,
Adjutant-General.

[Second indorsement.]

ORDNANCE-OFFICE, *July 13, 1872.*

Respectfully referred to the board on heavy ordnance, New York City.
 By order of the Chief of Ordnance.

S. V. BENÉT,
Mayor of Ordnance.

[Inclosure.]

OFFICE OF EAST SANDY-LLOYD OIL COMPANY,
 JACOB REESE, SECRETARY,
Pittsburgh, July 6, 1872.

The manufacture of cannon from Bessemer steel.—All steel that has been melted and "teemed" into molds is porous. I find this to be the fact with ingots and castings made from crucible cast-steel, Bessemer steel, and Sieman-Martin steel. In the manufacture of tool-steel, and other fine steels, the ingots are heated in a welding-furnace, and with the aid of a flux are brought up to a welding-heat, and then welded under a steam-hammer. This operation not only closes and solidifies the pores of the steel, but welds the pores into one solid homogeneous mass.

Rolling or pressing the steel only laminates the pores; welding is the only process known to the trade by which a perfect solid body of cast steel can be made.

In the manufacture of cannon I proceed as follows: Say for a gun of 4-inch bore, I cast an ingot of best cast steel, say 6 inches in diameter, and of required length of the gun. This ingot is taken to the welding fire, heated, and when at a welding heat taken to the hammer and welded. This operation will reduce the ingot to say 5½ inches diameter, and perfectly free from porosity. The ingot is then taken to a lathe and turned down to 5-inch diameter; this ingot or cast-steel core is again heated, and, the cannon-mold having been prepared, the hot cast steel core is placed in the center of the mold, and the Bessemer metal is teemed into the mold. It will be found that the metal teemed in will unite thoroughly with the cast-steel core, as though they had been welded together in the fire. The gun withdrawn from the mold is taken to the lathe, the "sinking-head" turned off, then to the boring-machine, where a 4-inch hole is bored in it; as this center-core is 5 inches, it will leave ½ inch of cast steel around the bore.

I do not confine myself to any thickness of the cast-steel center, nor do I confine myself to Bessemer steel for the body of the gun, but the distinguishing characteristic of my process is the making of cannon of cast-steel bore, welded to the body of the gun by teeming. The metal teemed may be of steel or of gun-metal.

I shall be pleased to demonstrate the facts of welding by flux, and welding by teeming, at any time at our works, (Fort Pitt Steel-Works,) should you deem it of interest. I thus secure a perfect fine-grained homogenous cast-steel bore to cannon, made of any kind of steel or pig-metal.

JACOB REESE,
*Of the firm of Reese, Graff & Co.,
 Fort Pitt Iron and Steel Works, Pittsburgh.*

L. B., No. 22.]

ARMY BUILDING, NEW YORK, July 17, 1872.

SIR: I am directed by the board on heavy cannon to acknowledge the receipt of your letter of the 6th instant to the Adjutant-General, proposing to construct a steel gun.

The board desires that you will inform it whether you are able to construct a rifle with a core of crucible steel and a jacket of Bessemer steel, in the manner proposed, of 12-inches caliber, weighing from 50,000 to 70,000 pounds, with the ability to fire a projectile weighing not less than 600 pounds, and with a charge of 80 pounds; and if so, that you will prepare the specifications for such a rifle, with the data as to cost, and present the same to the board as soon as practicable.

Very respectfully, sir, your obedient servant,

C. E. DUTTON,

First Lieutenant, Ordnance, Recorder.

JACOB REESE, Esq.,

Fort Pitt Iron and Steel Works, Pittsburgh, Pennsylvania.

No. 51.]

FORT PITT IRON AND STEEL WORKS,

REESE, GRAFF & Co.,

Pittsburgh, Pennsylvania, July 19, 1872.

DEAR SIR: Yours of the 17th is at hand. In answer say that I am not able at present to construct a rifle with a core of crucible steel and a jacket of Bessemer steel, of from 50,000 pounds to 70,000 pounds, as there is at this day no Bessemer plant with sufficient capacity to teem the jacket. The project is entirely feasible, and if the board desires I will prepare specifications of a plant with capacity to produce a rifle of from 10,000 pounds to 100,000 pounds. In the mean time I would suggest that an experimental gun shall be made of from 3 inches to 4½ inches bore. If this meets the approval of the board I will make out specifications, with probable cost, &c.

Yours, truly,

JACOB REESE.

C. E. DUTTON.

First Lieutenant Ordnance, Recorder, United States Army Building, New York.

L. B., No. 31.]

ARMY BUILDING, NEW YORK, July 23, 1872.

SIR: Your letter of the 19th has been received, and I am directed by the board to inform you that a 3-inch or 4½-inch rifle would not be satisfactory, as it would not be decisive of the success of such heavy rifles (10-inch and 12-inch) as come within the action of the board, but that the board would be pleased to receive specifications for a 9-inch rifle preparatory to the construction of a 10-inch or 12-inch rifle, and that for both of these guns (10-inch and 12-inch) specifications are invited, with estimates in each case of cost, &c., of the first guns and subsequent ones for service.

Your obedient servant,

C. E. DUTTON,

Lieutenant, Ordnance.

JACOB REESE, Esq.

No. 79.]

FORT PITT IRON AND STEEL WORKS,

Pittsburgh, August 6, 1872.

DEAR SIR: I am now prepared to contract for the construction of a steel rifle of from 50,000 to 70,000 pounds having a core of crucible cast-steel and a Bessemer jacket, the two metals being welded together by teeming.

I am now getting out samples of the metals welded by teeming, and will forward them in a few days. Will also endeavor to send you a partial estimate and specifications in a few days. I regret that I cannot do so this day.

Yours, truly,

JACOB REESE.

C. E. DUTTON,

First Lieutenant Ordnance, Recorder, Army Building, New York.

No. 84.]

FORT PITT IRON AND STEEL WORKS,

Pittsburgh, August 10, 1872.

DEAR SIR: I submit the following proposition to your board:

I will agree to construct a rifle on my process, the bore of which shall be made of crucible cast-steel of a tensile strength of 140,000 pounds to the square inch, and the jacket to be of Bessemer steel of 90,000 pounds tensile strength. Bore 10-inches diameter; weight, finished, not less than 55,000 pounds. The gun to be delivered to the

Government at the works where finished, and the testing of the gun to be at the expense of the Government. For and in consideration of the same the Government shall pay me the sum of \$153,604, the payment to be as follows: on the completion of the core-ingot the sum of \$10,000. If it proves defective, then on completion of a second core-ingot \$10,000. On the completion of the plant for the Bessemer jacket, \$31,750. Bessemer stock ready for melting, \$3,000. For the mold and accompanying operations for carrying the metal from the converters to the mold, \$5,320. For teeming, and before the gun is taken from the pit, which will require thirty days to cool, \$4,000. Should the gun be defective at this point, then on the completion of the teeming of the second gun the sum of \$37,320. For boring and turning when completed, \$13,061.50; the remainder of the \$153,604 shall be paid on the completion of the gun and its acceptance by the Government. The rifle to be ready for delivery on or before the lapse of twenty months from the date of the contract, and subject to regulations of the Department that may be hereafter agreed upon. After the completion of this gun, the plant, molds, machinery, &c., having been prepared and having experience, I estimate the cost of additional rifles of this class at the sum of \$40,000 each.

Yours, truly,

JACOB REESE.

C. E. DUTTON,

First Lieutenant, Ordnance, Recorder, Army Building, New York.

RODMAN RIFLES.

L. B., No. 17.]

ARMY BUILDING, NEW YORK, July 16, 1872.

SIR: The board on heavy cannon respectfully requests that you will forward for its information all records relating to the construction and trial of 12-inch and 8-inch Rodman rifles.

Very respectfully, sir,

R. H. K. WHITELEY,

Colonel of Ordnance, President of Board.

The CHIEF OF ORDNANCE.

No. 36.]

ORDNANCE OFFICE, WAR DEPARTMENT,
July 17, 1872.

SIR: I have the honor to send you to-day, in compliance with your request of 16th instant, the following documents from the files of this office, viz:

Documents.	File reference.
I. Relating to 8-inch Rodman rifles:	
Report of inspection and proof of an 8-inch rifle at Fort Pitt, February, 1862	Insp.—1—93.
Record of firing with above rifle at Fort Monroe arsenal to 1,028th round	In guard book.
Letter of Major Rodman, February 9, 1863	1—W—392.
Letter of Major Rodman, March 1, 1865	1—W—417.
Report of casting and cooling pair 8-inch rifles at South Boston Foundry, April, 1865	1—R—100.
Tracing of above pair of 8-inch rifles, with cross-sectional views showing rifling, (four tracings.)	1—A—303; Dr. 21, Port 1, No. 23.
Record of firing above pair of 8-inch rifles	In guard book.
II. Relating to 12-inch Rodman rifles:	
Report of inspection and proof of 12-inch rifle at Fort Pitt Foundry, 1861	Insp.—1—9.
Record of firing above 12-inch rifle to 472d fire	In guard book.
Letter of Major Rodman of September 10, 1863	1—W—11.
Letter of General Rodman of August 4, 1868	1—R—153.
Letter of General Rodman of August 15, 1868	1—R—156.
Tracing of 12-inch rifle, (being inclosure to above letter of August 15, 1868)	1—R—156; Dr. 21, Port 1, No. 6.
Report of inspection and proof of 12-inch rifle made at South Boston Foundry October 23, 1868	Insp.—1—644.
Letter of General Rodman, October 29, 1868	1—R—160.
Record of firing the South Boston 12-inch rifle at Fort Delaware, 2 rounds	In guard book.
Record of firing the Fort Pitt 12-inch rifle at Fort Monroe Arsenal, 27 rounds	In guard book.
Drawing of 12-inch rifle, model 1870	1—R—173; Dr. 21, Port 1, No. 24.
Memorandum on initial strain, by General Rodman, March, 1869	1—R—163.

The board is earnestly requested to exercise watchful care over the above documents. They belonging to the archives of this office, to which they are to be returned when the board is through with them, together with all other original papers supplied from this office.

Respectfully, your obedient servant,
By order of the Chief of Ordnance :

S. V. BENÉT,
Major of Ordnance.

The PRESIDENT OF THE BOARD ON HEAVY ORDNANCE, *New York City.*

[NOTE.—The papers sent under cover of the above letter of transmittal are entirely too voluminous for publication.]

RUSSIAN HEAVY GUNS.

H. O., No. 3a.]

NEW YORK, 239 WEST TWENTY-SECOND STREET,
June 26, 1872.

DEAR COLONEL :

I give you here, as promised, the information about the pressures in our large coast cannons.

Cannons.	Weight of projectile.	Weight of powder in the charge.	Initial velocity.	Maximum pressure per square inch.
	<i>Pounds.</i>	<i>Pounds.</i>	<i>Feet.</i>	<i>Pounds.</i>
11-inch rifled.....	497	82.6 prismatic.	1,360	47,280
9-inch rifled.....	275	46.9 prismatic.	1,338	45,692
8-inch rifled.....	174	28.4 prismatic.	1,280	44,202

All measures are English.

Very truly, yours,

A. DE GORLOFF,
Major-General of the Suite of His Majesty the Emperor of Russia.

Colonel S. V. BENÉT.

[Indorsement.]

UNITED STATES ORDNANCE AGENCY, NEW YORK,
July 10, 1872.

Respectfully referred to the board of heavy ordnance convened by General Orders No. 57, dated June 28, 1872.

S. CRISPIN,
Brevet-Colonel United States Army, Major of Ordnance.

C. W. STAFFORD.

No. 74.]

NEW YORK, *July 31, 1872.*

GENTLEMEN: General Orders 57, of June 28, was sent me through Samuel B. Smith, by mistake, and remained in his office until the 26th, and only reached me yesterday. I desire, therefore, to be informed if I am still in time to submit some improvements in heavy ordnance which were left in charge of Mr. Smith, but sickness prevented him from giving the matter such attention as I would otherwise have done. Mr. Smith has such drawings and other things pertaining to this matter at Washington, and will no doubt bring the same to your notice if allowed to do so.

I increase the tensile strength of the cast iron, by a process which has been fully tested, more than 100 per cent., and my system of compound re-enforce and trunnion bands, together with the great strength of the metal, will make a gun that will stand greater strain, and at a less cost, than anything that has been produced.

I respectfully refer you to the reports of Chief Engineers Wood and Faron, who have tested the metals, and also to the specifications, plans, drawings, patents, &c., covering the improvement.

My system of compound or double-re-enforce bands will be found of great importance and value for heavy ordnance, and I hope you will not overlook it.

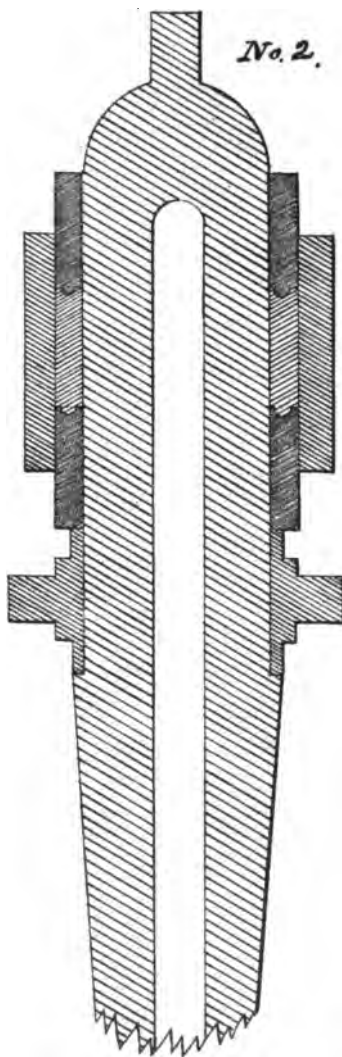
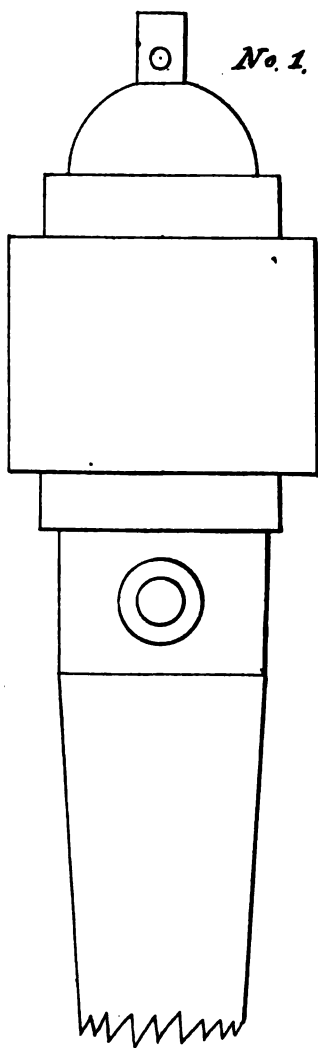
Very respectfully, &c.,

C. W. STAFFORD.

C. W. STAFFORD,

Improvement in Ordnance.

Pat. Feb 21, 1865.



L. B. No. 44.]

ARMY BUILDING, NEW YORK,
August 7, 1872.

SIR: Your letter to the board on heavy cannon is received.
If you will forward your plans without delay they will be duly considered by the board.

Very respectfully, sir,

C. E. DUTTON,
First Lieutenant Ordnance, Recorder.

C. W. STAFFORD, Esq., 948 Broadway.

No. 96.]

NEW YORK, August 10, 1872.

GENTLEMEN: I have the honor to send drawings of my system of re-enforce and trunion bands, patented February 21, 1865.

I am also the owner of the Everett process for increasing the tensile strength of cast iron, some reports of which were made at the Philadelphia and Washington navy-yards, and by others, which will give some information of its value. Heavy ordnance can be constructed in this way that will be found to have all the strength and endurance of any metal in the world, and at a cost of one-half of steel or wrought iron.

If the Department should desire to test this, the Government shall have the right to construct any gun or guns, say from 100-pounders to 10-inch bore, and put them to the hardest possible test, say 1,200 rounds, and then continue until the gun shall burst or become useless. If, after such trial, it shall be found that this metal and this system is of sufficient value to warrant its use, then, and not before, shall any charge or cost to the Government be made, so far as the use of either the process or the guns as constructed under my patent; and in the event of satisfactory tests the Department shall have the right of both at a valuation to be made by any officer appointed by the Government, and one chosen by myself, who is to fix upon royalty or price.

I am, gentlemen, very respectfully, &c.,

C. W. STAFFORD.

E. A. SUTCLIFFE.

No. 101.]

NEW YORK, August 22, 1872.

GENTLEMEN: Herewith I desire to submit to your consideration my plan for a breech-loading cannon, transmitting to you my letters-patent and a model illustrating the same.

E. A. SUTCLIFFE,
402 Bleecker Street. Residence, 612 Hudson Street, New York.BOARD ON HEAVY CANNON,
Colonel R. H. K. Whiteley, President.

[Inclosure.]

(No. 39,596, dated 18th August, 1863.)

Schedule of letters-patent issued to E. A. Sutcliffe.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and operation:

A is the gun, bored right through the breech, counter-bored at the breech, and having a screw-thread, *a*, cut in the counter-bore for the reception of the breech-tightening and sustaining screw B. This screw is bored centrally, of a caliber slightly larger than that of the gun, to permit the projectile and the cartridge to pass easily through it. This screw is furnished at its rear end with a suitable lever or levers *d*, to which to apply the necessary power to turn it. *e* is the mortise cut in the gun, immediately in front of the counter-bore of the breech, for the reception of the movable breech-pieces C. This mortise is of a width from side to side greater than the caliber of the gun, and of a depth from back to front slightly greater than the thickness of the breech-piece C. It is cut from the under side of the gun across the bore and its upper part is finished in semicircular form, with a radius equal to half its width, as shown in Figs. 2 and 3, having the upper part of the gun closed, as shown in the figures. The breech-piece C consists of a flat, circular disk of steel or other metal of a diameter slightly less than the width of the mortise *e*, but sufficiently greater than the caliber of the gun to give it a good bearing against the front of the mortise when closed. This breech-piece is so

attached near its circumference by a pin, *c*, to the front end of the screw, *c*, that it may come to a position concentric with the screw and the caliber of the gun, as shown in Fig. 2, when the screw is screwed up tightly against it, as shown in Fig. 1, at which time the pin *c* is directly over its axis. The said pin is secured firmly in the screw and the breech-piece hangs loosely upon it.

To open the breech the screw is turned back to the extent of a half revolution, which brings the pin *c* below its axis, and by this means the breech-piece, being liberated from the end pressure of the screw, is caused to roll down one side of the mortise and drop to the position below the bore of the gun, shown in Fig. 3, leaving an open passage through the screw into the gun for the admission of the projectile and cartridge. After the insertion of the projectile and cartridge the screw is screwed in to the extent of half a revolution and the pin *c* raises the breech, which rolls up one side of the mortise until it arrives in the position shown in Fig. 2, when the screw comes hard up against it and secures it to close the breech for firing. If it be required to take out the breech-piece for cleaning or repairs or for disabling the gun in case of necessity, the screw is turned back to the extent of one or more revolutions, or until the pin *c* is withdrawn from its hole in the breech-piece, when the latter drops out through the open bottom of the mortise. I do not claim broadly the combination of a hollow tightening and sustaining screw with a movable breech-piece; but what I claim as my invention and desire to secure by letters-patent is connecting the movable breech-piece *C* with the hollow tightening and sustaining screw *B* by means of a pin, *c*, or its equivalent, by which the turning of the said screw in and out is made to raise and lower the breech-piece and so close the breech of the gun, substantially as herein described.

ELISHA A. SUTCLIFFE.

D. K. SWISHER.

L. B. No. 21.]

ARMY BUILDING, NEW YORK,
July 16, 1872.

SIR: I am directed by the board on heavy cannon to inform you that your letters to the Secretary of War and to the Adjutant-General have been referred to it, and the decision is that your proposition does not come within the purview of the board, which was convened for the purpose of recommending for trial heavy rifled cannon.

Very respectfully, sir, your obedient servant,

C. E. DUTTON,
First Lieutenant Ordnance, Recorder.

D. K. SWISHER, Esq.

JOHN A. TERRELL.

No. 94.]

POST-OFFICE DEPARTMENT,
OFFICE OF THIRD ASSISTANT POSTMASTER-GENERAL,
Washington, D. C., July 9, 1872.

SIR: On behalf of my brother, Mr. John A. Terrell, of Bloomfield, Kentucky, I have the honor to submit a model of his improvement in heavy ordnance, with a communication, bearing his signature, inclosing explanatory documents and papers relating to said improvement, all which I respectfully request may be presented, for examination and report, to the board of ordnance shortly to assemble in the city of New York.

I am, sir, very truly yours,

W. H. H. TERRELL.

The ACTING CHIEF OF ORDNANCE,
Ordnance Bureau, War Department.

[Indorsement.]

ORDNANCE-OFFICE, July 9, 1872.

Respectfully referred to the board, with model and papers.

By order:

S. V. BENÉT,
Major of Ordnance.

E. A. SUTCLIFFE'S Breech-Loading GUN.

Fig. 1.

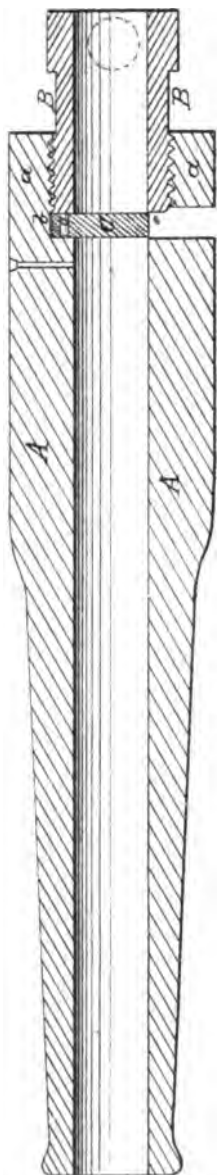


Fig. 2.

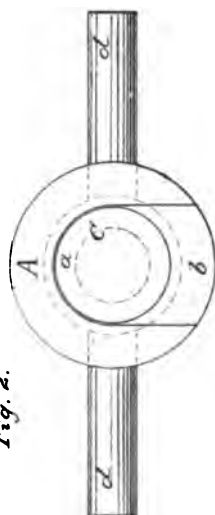
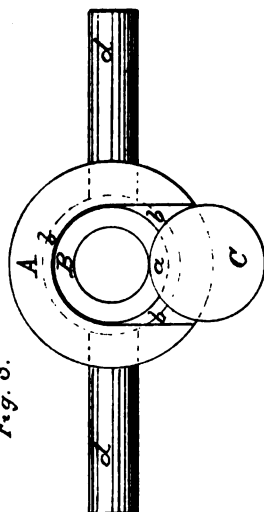


Fig. 3.



[Inclosure.]

BLOOMFIELD, KENTUCKY, July 5, 1872.

SIR: Referring to your courteous letter of March 15, 1871, addressed to my brother, General W. H. H. Terrell, (Assistant Postmaster-General,) in which you kindly promised to bring to the notice of the next ordnance board my improved cannon, with the view of having a report made upon its merits, and having just learned that a board of officers has been appointed to meet in the city of New York, on the 10th instant, for the purpose of examining models of heavy ordnance and reporting thereon for experimental tests, I have the honor respectfully to submit, for the consideration of the board, a small wooden model, with explanatory cuts, of my invention; also, some descriptive newspaper articles;* a copy of a report made March 10, 1871, by a board of officers of the Navy Department, in which my gun is considered in relation to its resistance to a bursting force; and a paper containing my answer to the objections set up in said report, with a general explanation of the principle and theory upon which my invention is based.

The description contained in the *Scientific American* is incorrect in one particular. It is not proposed to cast the re-enforce, or "jacket," of the piece in "cross-sections," for by so doing the longitudinal support of the re-enforce would be lost and the interior barrel would be required to sustain the longitudinal strain.

The principal feature of my invention is a perforated re-enforce, or "jacket," an internal support to the interior barrel of a heavy gun.

The plan upon which the gun may be constructed is fully set forth in the accompanying papers.

The breech-loading and elevating devices may or may not be of value, but are submitted for what they are worth.

The gun may be constructed upon either the breech-loading or muzzle-loading plan.

Trusting the ordnance board will duly examine my invention and carefully consider the evidence and arguments I have adduced in its behalf, and that I may be favored with a copy of the report when made,

I am, sir, very respectfully, your obedient servant,

JOHN A. TERRELL.

General A. B. DYER,

Chief of Ordnance, War Department, Washington, D. C.

[Inclosure.]

[Extract from *Scientific American*, March 25, 1871.]

IMPROVEMENT IN HEAVY ORDNANCE.

The principle of this gun was first suggested by the explosion of the great wrought-iron gun "Peacemaker," on board the *Princeton*, on the Potomac River, in 1843, by which Secretaries Upshur and Gilmer, of President Tyler's cabinet, and others, lost their lives. A model of it was exhibited at the Ordnance Office, in 1852, but the theory of its construction was then regarded as paradoxical, and no attention was paid to it. Letters-patent upon it were obtained in December, 1868, and, at the same time, steps were taken to secure patents in Europe.

The part which contains the bore is a steel cylinder, cast with walls of a uniform thickness of two inches, which secures homogeneity in the casting, and provides against cooling strains and flaws. To receive this steel barrel, an iron re-enforce of great thickness is cast, with a caliber a little less than the entire diameter of the barrel. In the walls of the re-enforce are eight rows of perforations, having the outlines of truncated cones disposed in equilateral triangles, the small end of the openings, two inches in diameter, being upon the internal surface of the re-enforce. These perforations and the bore are formed by cores, fixed on the flask or pit when the metal is cast. By thus multiplying the cooling surface, the requisite tensile strength may be obtained with less danger of flaws and neutralizing strains, when the mass of metal "sets," as all foundry-men know.

To receive the steel barrel, the re-enforce is expanded by heat. It may be cast in sections, thus saving the great inconvenience attending the handling of the same if cast entire, and, in case of flaws in the casting, involving only the loss of the section in which they occur.

The barrel, when inserted, is firmly compressed as the iron cools; but since it is not otherwise secured, its longitudinal expansion, from the heat of discharges, is not so cramped as to cause a rupture. The radial expansion of heat is partly provided for by

* Omitted from this publication, excepting a description from the *Scientific American*.

the elasticity resulting from the internal support received from the re-enforce; but in this regard the main reliance is upon the immense radiating surface, penetrating to the very core of the gun, and preventing the accumulation of heat at the dangerous points within the walls.

A gun thus constructed will, it is claimed, stand the rapid and continuous firing of solid shot indefinitely, without danger of bursting. The theory is that the rapid firing of a thick-walled gun, made after any of the present approved models, must necessarily produce a degree of heat sufficient to cause unequal expansion in the mass of metal, and thus create cracks, or, at least, strains that will inevitably result in rupture when re-enforced by the pressure of subsequent discharges. No gun now in use is so constructed as to be guarded against the silent power of this insidious and tremendous agent. The inventor believes that, with the requisite strength of wall, durability can only be obtained by providing for the harmless and safe escape of this force, and that his perforated re-enforce supplies this provision.

Another original feature of Colonel Terrell's invention is its ingenious breech-loading apparatus. Reference to the engravings will enable the reader to understand the details of this feature. Fig. 1 is a perspective view of the gun. Fig. 2 is a vertical longitudinal section, showing the hinged breech-plate and devices for holding it in position. The dotted outlines show the parts in position for firing. Fig. 3 is a top view of the hinged breech-plate, and the screw which holds it in its place when adjusted for firing, the screw being in the position shown in the dotted outline, Fig. 2, but the breech-plate being dropped into position for loading. Fig. 4 is a cross-section showing the form of the rifled grooves and conical perforations in the re-enforce. Fig. 5 is a detail-view of the device for expending the charge.

A massive slotted breech is cast to the re-enforce. In the walls of this slot is hinged the solid and close-fitting breech-plate. This is firmly compressed against the chamber by the powerful set-screw, turning in a swinging nut, hinged in the rear end of the slot and resting against its shoulders when in position. This screw is located out of all danger of fouling, which occurs when the screw is inserted in the rear end of the bore. By giving the screw a turn or two, it and the breech-plate are loosened, and swing by their own gravity through the slot, thus leaving the way clear for swabbing and charging the piece.

To raise or lower the muzzle without loss of time, elevating-screws of various lengths are screwed into a revolving bar, which has its bearings in the gun-carriage below the cascabel. To prevent the injuries which result from priming-tubes located in the body of the gun, the device for exploding metallic cartridges, Fig. 5, is fixed in the breech-plate; and when such cartridges are not used this contrivance can be withdrawn, and the slanting tube it occupied can be used as a receptacle for priming. The inventor of this gun is Colonel John A. Terrell, of Bloomfield, Kentucky.

The principal item of cost in the gun is the barrel or inner core. The gun has, we are informed, attracted much attention, and there are not wanting those who predict that it will effect a revolution in heavy ordnance.

[Inclosure.]

BUREAU OF ORDNANCE, NAVY DEPARTMENT,
March 10, 1871.

SIR: We have carefully examined the model of a perforated re-enforce gun and the accompanying descriptions and discussion of the theory upon which it is constructed, presented by Mr. John A. Terrell.

We will first consider it in relation to its resistance to a bursting force. It is evident to us that, if an equal number of conical holes were drilled in a solid casting, the break of continuity in each circular element must weaken the gun, and we do not think that this loss of strength is compensated by boring the casting to relieve cooling strains. All the experiments hitherto made show that, owing to their unequal elasticity and expansibility, it is impossible to insert a steel tube in a cast-iron gun in such a manner as to afford a continuous support to the tube; therefore we must rely on the tube alone to sustain the effect of the charge. If we do this, we have at once a steel gun, and, hitherto, no steel gun has been made to certainly sustain large charges.

The principal object of these conical openings is to allow a greater surface for radiation of heat, which, according to the "heat theory," is an important element in causing the rupture of cannon.

Although it would at first appear that the surface of the bore, which is in contact with the inflamed gases at a high temperature, would be raised to something near that degree of heat; yet, during the experimental firing of the 15-inch gun at Pittsburgh, the temperature of the bottom of the bore, after repeated and rapid firing, was only 82°, the temperature of the external air being 40°. It is also a matter of universal

Fig. 1.

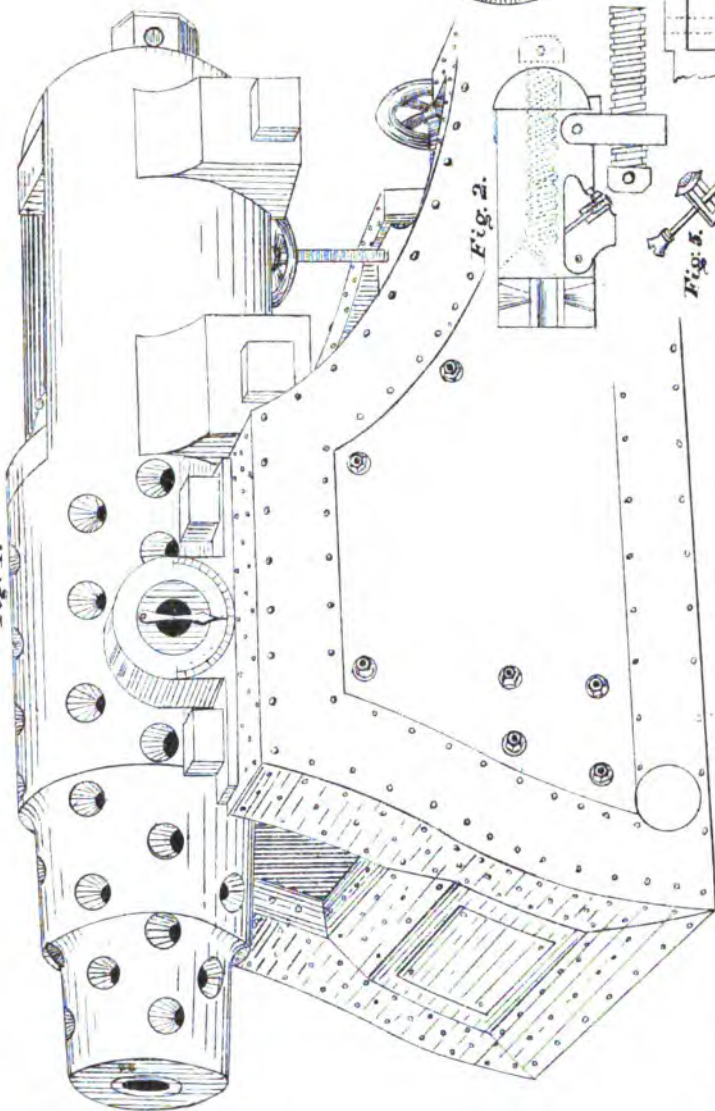


Fig. 4.

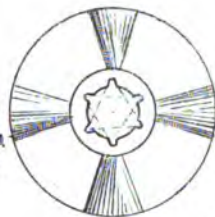


Fig. 3.

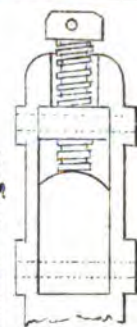


Fig. 2.

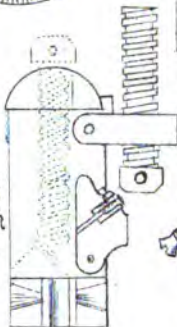


Fig. 5.



Terrell's Perforated Reinforce Cannon. —
Breech Loader.

naval experience that the coating of bees-wax, with which the naval gun is always covered, is never melted by the most rapid firing under a tropical sun.

It is therefore very doubtful if this cause, the difference of temperature between the internal and external surfaces, produces the serious effects attributed to it.

As this objection is founded on theoretical considerations, it can only be satisfactorily sustained or refuted by the actual test of a trial gun of not less than 10 inches caliber, if a rifle, or 15 inches, if a smooth bore.

We are, very respectfully, your obedient servants,

H. K. DAVENPORT,
Captain United States Navy.
WILLIAM N. JEFFERS,
Captain United States Navy.

Commodore A. LUDLOW CASE,
Chief of Bureau of Ordnance.

OBJECTIONS ANSWERED—GENERAL DESCRIPTION AND ARGUMENT IN FAVOR OF THE IMPROVEMENT.

The bursting force is of two kinds, namely, explosive or projectile force and the expansive force of heat; the former ceases when the shot leaves the gun, while the latter is increased by every shot fired from the gun. If the gun is composed of wrought iron or steel, the force of this internal-heat expansion must be sustained by the strength of the wall alone. The nature of wrought iron or steel precludes the idea of its accommodating this expansion by the compressibility of the walls, for there is little or none of it in such metal. Hence the experience of the Ordnance Department, "that hitherto no steel gun has been made to *certainly* sustain large charges." If the walls are thick, certainly not.

And I may add the same of wrought iron. In practice, its use in such guns has shown only a small improvement; instance the "Peacemaker" on board the steamship Princeton. If the gun is fired rapidly with large charges of powder and heavy conical shot, the heat from such discharges must increase the radius and longitude of the bore. If the gun be a heavy one, with thick walls, its thickness must prove a point of weakness, because the gun will remain unexpanded on the outside, but will be expanded on the inside. If there is much porosity in the metal—and there will be some if it is made of cast iron—as the heat expands, the inside metal will compress, or the porous quality will be forced together if the firing be continued long enough to force this spongy quality into a solid mass, when, if this increasing cause be continued, the gun must soon become so strained that a rupture will ensue. And we infer that this is one reason why many artillerymen say that in practice "a thick wall in a large gun is a point of weakness;" that it is not a positive insurance against the bursting force, and more especially is this the case if the metal of which the gun is composed is wrought iron or steel.

The unequal expansion of heat operating on a mass of metal that has been unequally or unevenly cooled, must have a very great influence in the destruction of many valuable guns of large caliber. This force is unquestionably unmanageable in an ordinarily constructed large gun, and is destruction to it unless some avenue is provided for its harmless escape. We present our perforated re-enforce as a rational remedy for this defect. Nearly all scientific men admit the correctness of the "heat theory," but so far as we know it has had no satisfactory test. We propose to make this, but before we proceed to do so on our own account, we ask the Government to do it, for if anybody is to be benefited by it it will be our Government.

If a large gun with thick walls be made of cast iron upon the Rodman plan, the surface of the bore will doubtless be contracted and show less porosity, but as it has not been perfectly steeled it will, by use, in a short time resume its former porosity; at all events, the wall of such a gun will be, to a certain extent, compressible, much more so indeed than that of a steel or a wrought-iron one.

The practical result is apparent, that the wall of such a gun will compress under strain to a very great extent, and in many instances will accommodate this internal expansion. But if the expansion is greater than the compressibility of the metal a rupture will ensue and a failure will be the result. Hence the great fatality attending steel guns. We think this must be plain to any constructor of ordinary experience.

If the gun be made of cast iron on the Dahlgren plan, its power of endurance will be greater, but even in this regard they are limited, for the reasons before stated. It must be remembered that I am speaking of heavy guns, with thick walls, using large charges and solid conical shot, and to be fired rapidly, as occasion and emergency may require.

In connection with the foregoing it is desirable to know why guns of ordinary caliber and thickness of wall are safe and durable, while nearly all rifles larger than 30-

pounders are utterly unsafe when fired rapidly with large charges and elongated shot. Why may not the thick walls of a 10-inch gun be made strong enough to stand the pressure of a proportional charge as well as the thinner walls of an ordinary field-piece? And why has the massing of various metals in divers methods about the chamber left the strongest walls more liable to explode than thinner and weaker ones? The uniform pressure of exploding gunpowder is measurable and so is the strength of metal.

Captain Andrew Noble, F. R. S., in his researches upon the explosive force of gunpowder, says, upon the subject of the tension of powder-gases, that they were "generally registered extravagantly high." "Experiments had shown the pressure of R. L. G. powder to be about 32 tons to the square inch. The pressure indicated by the L. G. powder was 37 tons on the square inch."

The following are the practical conclusions deduced from the investigations:

First. The maximum of pressure of fired gunpowder is not much above 40 tons to the square inch.

Query: If 40 tons to the square inch is the maximum of pressure of fired gunpowder, what breaks the steel guns? It cannot be caused by the projectile force alone. Does it not look like the unequal expansion of heat has something to do with it?

Second. In large guns, owing to the "violent oscillations produced by the ignition of a large mass of powder, the pressure of the gas is liable to be locally exalted even above its normal tension in a perfectly closed vessel; and this intensification of pressure endangers the gun, without adding to its useful effect."

Third. Where large charges are made, quick-burning powder increases the strains upon the gun without augmenting the velocity of the shot.

Fourth. The position of the vent or firing-point exercises an important influence on the intensity of wave-action, and in further enlarging the dimensions of heavy guns we must look to improved powder and improved methods of firing the charge, so as to avoid as much as possible throwing the ignited gases into violent oscillation.

Fifth. That in all cases it is desirable to have the charge as short as possible, so as to reduce the run of the gas to the shortest limit. Hence increase of the diameter of the gun, by shortening the charge, tends to save the gun from abnormal strains.

By referring to the cut of our muzzle-loader you will notice that the igniting-tube, or vent, is central, the powder is ignited at the base of the shot, the gas overcoming its inertia, the powder burning backward, thus obviating that violent oscillation, giving the shot an accelerating motion.

By this arrangement the combustion of the powder is slightly prolonged; at least the full forces of all the gases is not put into such a state of violent oscillation as would be the case if ignited at the bottom of the powder-bed or at a side vent. We thus avoid the danger of abrasion and deterioration.

Should the breech-block or screw-plug, through which the vent is made, become deteriorated from long use by rapid and continuous firing, it can be removed and a new one substituted. By this arrangement we lengthen the lives of our heavy guns beyond the time of allotment by the regulations.

It will be observed, from the printed description of our proposed gun, that the re-enforce is to be cast with eight rows of perforations disposed in equilateral triangles; these apertures are to be formed by cores set in the mold or flask; in this manner we multiply the cooling surface, the requisite tensile strength is obtained with less danger of flaws and neutralizing strains.

You will please notice in the small exemplifying model that the walls of the re-enforce are to be of great thickness; whatever amount of metal which may be necessary to take out of it to form these apertures is to be added to the thickness of the wall.

By examining the model and the cuts you observe that there is about as much metal resting against the core or barrel (and sustaining it) as there is on the outside of the gun.

In constructing a 20-inch gun on this plan, the wall of the bore or barrel would be five inches thick, or one-fourth the diameter of the bore; five inches will then be the diameter of the apex of the conical apertures. (See cut Figs. 3 and 4.)

But to make sure of giving ample strength to our first experimental gun, we will reduce the diameter of the apex to about two and a half inches.

Referring to cut Fig. 3, and taking the point equidistant on the inside of the core, (which will give the angle of truncation,) we will have about the same amount of metal, or strength of wall, at every point in the re-enforce from the casable to a point beyond the trunnions, as is shown in the cut. The trunnions are cored and cast hollow, but the amount of metal taken out to form the aperture is supplied to their size. By this arrangement the heat cannot remain any length of time at that point, but will be radiated away. Solid trunnions have a tendency to act as a compass, holding the outside of the gun at that point against an expanded inside; hence the perforation. The core or barrel is to be constructed of the strongest metal, to be tested by hydraulic pressure. The iron re-enforce, having been trued out, is slightly expanded by heat. When the barrel is placed inside of it, the re-enforce shrinks firmly on the core and becomes an interval support to it.

Terrell's Muzzle Loader.

Fig. 2.

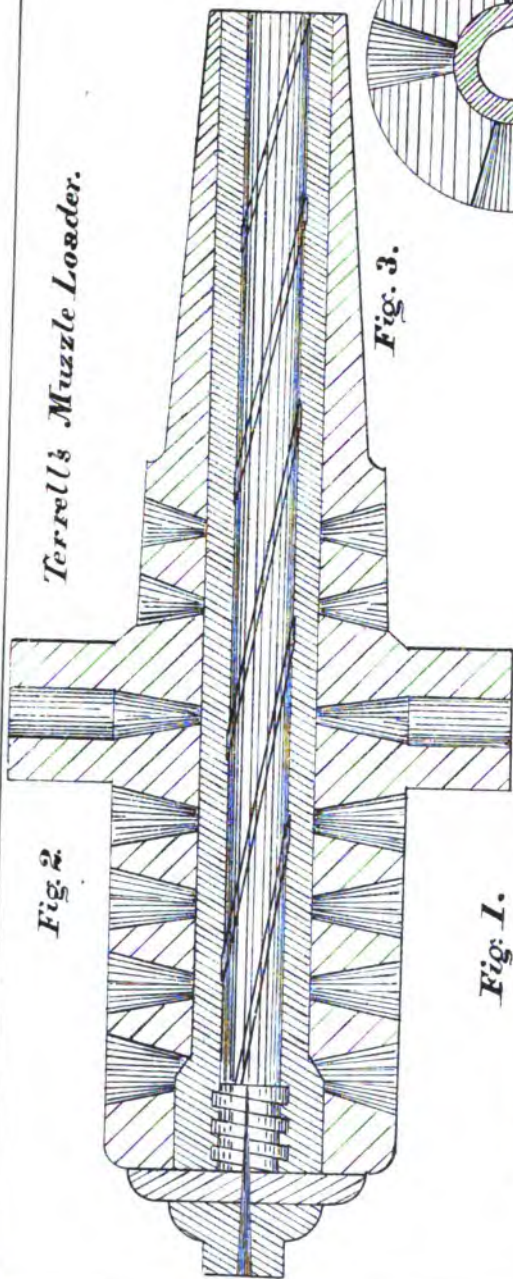


Fig. 3.

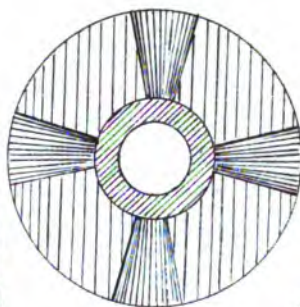
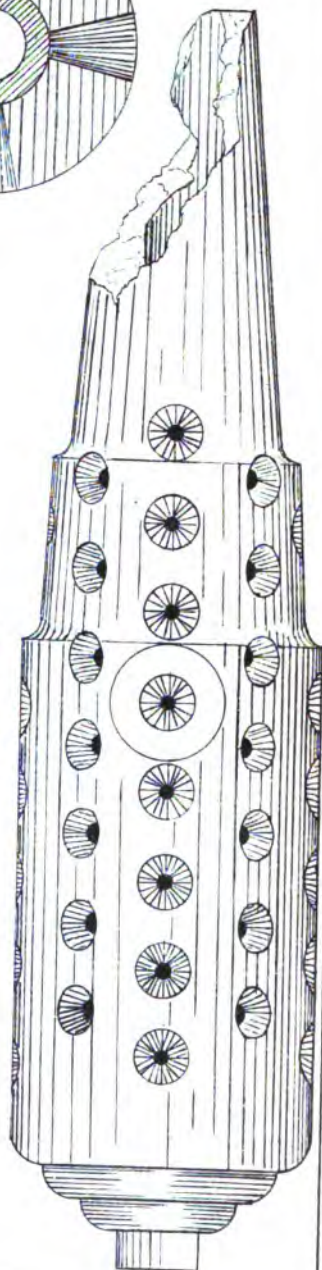


Fig. 1.



So far as the unequal elasticity and expansibility of steel and iron is concerned, (if we have not made a wrong estimate,) it is exactly what we want.

Dr. Joule, at a meeting of the Literary and Philosophical Society, Manchester, stated that the experiments of Lavoisier, Laplace, Smeton, Dulong, Petit, and of Toughton gave a less expansion by heat to steel than iron, especially if the former be in an untempered state.

We are satisfied that our experiments justify us in accepting the above as true. So much, then, for the expansibility of steel, and if we are correct in our estimates, steel is exactly suited for our core or barrel. It must be remembered here that it requires the frequent heating of steel, and that to a temperature 212° , before there is a probability of relaxing the rigid cohesion of its particles. This much for the strength of steel. But grant (if you please) that the elasticity and expansibility of the steel core and iron re-enforce is unequal, we think you will observe that we have made ample provision for it. We admit that it would be a failure in practice to "insert a steel tube in a cast-iron gun" with solid walls. But we do not admit that we cannot do it in a perforated wall, for we do know that we have done it.

It is true that we have not a continuous support, but we have what will prevent the gun bursting, and that is an interval support. But we can't see that we rely alone on the steel tube to sustain the effort of the charge, for most certainly does the re-enforce sustain and support the tube at intervals, to say the least of it. But we do say that the support is, in practice, a continuous one, and proceed to proof by comparison.

If a continuous support is so necessary to sustain a force, why is it that in the construction of our railroads an interval support is furnished to the track-bar instead of a continuous one?

The native elasticity of the track-bar is preserved if supported at intervals by cross-ties, and this you will find to be a very important part of its strength.

If you wish to break a bar of steel, deprive it of its elasticity by placing it in contact with a perfectly solid body, and strike it a heavy blow immediately over that point of contact, and you will find it quite easily broken; but the reverse will be the result if the bar is not deprived of its elasticity. In the latter case it will give, when struck, with the blow, and thus prevent the crushing effect of the stroke. The inference to be drawn from the above illustration is that a very small amount of elasticity will, it is confidently believed, have a decided tendency to prevent a rupture in a gun, provided it is furnished to the outside of the gun, to compensate for the inside expansion.

We find, in the construction of wire suspension-bridges, that the interval support provided in their construction is justly considered a point of strength, and it so stands in theory and proof. Such a structure will endure the variations of temperature longer than a bridge with continuous sides, made of solid cast or wrought iron with unbroken or continuous walls, because there is some elasticity in the former where the continuity is broken, and none in the latter where it remains intact. Again, and to illustrate the operation of heat in a large casting, the larger it is the less solid will its interior be when cooled, because, at the last point of cooling (as the mass of metal sets) it will show an unequal porosity according to its unequal cooling, and the consequence will be that it will possess less uniform strength to resist a direct force not possessing a uniform density. This being the case, the operation of heat upon the mass would expand it more in some places than at others; the expansion would be unequal, causing it to warp and crack, and, finally, to fail in its office of support. But this is not so likely to be the case with the wire bridge, because the metal used in its construction is not deprived of its native elasticity to prevent its yielding to the weight upon it and to the pressure caused by the expansive force of heat, it being slightly elastic, which is an important point in its strength. In like manner will it be with the wall of a large gun, if this provision is made, by using a re-enforce or interval support to the barrel of the gun, casting it on cores, causing it to cool more evenly, with fewer internal fissures or flaws. We observe this principle in buildings constructed with arched openings formed in one of the side walls, while the opposite wall would be constructed entire. Both walls are required to support joists for additional stories, and no practical mechanic would think that the wall with the arched openings in it would be more liable to fail in its office of support than the entire wall, notwithstanding the continuity in it is broken; but this appears not to impair its strength. An interval support seems to answer the purpose of furnishing a support on the perforated side-wall equal to that found in the entire wall.

Why will not this same principle of an interval support be adequate to resist all the force in a large gun?

There is scarcely a doubt but that the unequal expansion of heat has greatly assisted in the destruction of many very valuable guns of large caliber, and more especially has it been the case with guns made of wrought iron and steel, the metal in such guns being less porous than cast iron, consequently less compressible.

Doubtless this is one reason why the Dahlgren guns have shown so much endurance

in our naval contests, and it is believed by many intelligent officers and mechanics that this result is attributable to the fact of its being cast solid and bored out to form the barrel. By this process it is made to possess more porosity in its walls and is more compressible. But if this gun, with all of its porous quality and compressibility, is subjected to continuous and rapid firing with large charges of powder and solid conical shot, the metal in it would soon become compressed to the extent of its compressibility by the force from within, and would then be no safer than a steel or wrought-iron one.

The thinness of the walls in our field-guns is doubtless one reason why they so seldom explode.

The opening in our re-enforce for large guns provides for the escape and radiation of heat from a dangerous point, and also furnishes a small amount of elasticity to the outside of the gun to compensate for the inside expansion caused by heat from rapid firing, friction, compression, and the resistance of the solid shot. This heat increases the radius as well as the longitude of the bore against a comparatively cold outside, which does not become sufficiently hot (outside) by rapid firing, even under a tropical sun, to melt the coating of wax with which the Navy guns are always covered.

But it is not so much heat that breaks the heavy gun as it is the unequal expansion caused by it that greatly assists in doing this. Fire a gun rapidly with a wet blanket on the outside to keep it cool, and the gun will crack from the unequal heating, and if the gun is a large one, with thick walls, it will the more surely explode. But reverse it, if you please. In the place of the wet blanket on the outside of the gun apply heat to it, so that the outside of the gun is expanded equal to that of the inside, and the gun will not explode, and if the gun is a large one, with thick walls, made of steel or wrought iron, it will the more surely not explode.

A very simple experiment may be had to prove this by placing a glass tumbler in cold water and pouring boiling water into it; the contraction of the outside by cold and the expansion of the inside by heat causes it to break. But reverse it; subject the inside and outside of it to a graduated heat at the same time, and it will never break. So that it must appear plain that it is the power of unequal heating or unequal cooling that plays such havoc with our heavy guns.

Some intelligent mechanics seem to think, on a first inspection of our model, that the gun will be strong enough radially, but laterally it will be defective in point of strength; that the wall of the core or barrel being only about five inches thick in a 20-inch gun, it will pull in two from the force of the gases acting against the projectile and breech-block.

But evidently this opinion is erroneous, because the heat of discharge expands the core against the re-enforce, and the adhesion of the parts (core and re-enforce) furnishes double the support and strength required.

As before stated, the conical apertures supply a small amount of elasticity to the outside to compensate for inside expansion, the smallest amount of which, in many instances, doubtless prevents a rupture.

So, in like manner, will this cause act in other constructions.

The construction of an ordinary wagon-wheel is in point. The pressure hinges in the hub, and is received at the rim of the wheel, supported by the spokes, which are an interval support, in which the continuity is broken, and withal is one of the finest combinations of mechanical strength to be found.

Would its power of endurance be improved by making the continuity of the spokes complete, or solid from rim to hub?

If we do this we deprive it of its elasticity, which would, in a practical point, destroy the strength of the vehicle upon which it is to be used, and if so constructed throughout would not possess that power so necessary to resist the impact received from rough thoroughfares in trundling its ponderous loads.

It is confidently expected that our perforated re-enforce or interval jacket-support, when fairly considered in all of its points, will prove a rational remedy for the defects known to exist in heavy ordnance, and that it will be fully able to sustain double the pressure required, and also furnish an escape for a silent and insidious agent which has heretofore been unmanageable and uncontrolled.

A gun, when subjected to hydraulic pressure, sustains a direct force. The action of the water does not change the structure of the metal; but under rapid firing the gun is not only required to sustain the force of the gases of burning gunpowder, coupled with the resistance of the shot, but it must sustain the pressure of the expansive force of heat, which does change the structure of metal by unequal expansion, thus breaking up the fibrous continuity of the rigid cohesion of its particles.

It appears that steel has not given satisfactory results as a metal for large guns; consequently it has been condemned or rejected for such purposes. It certainly is a stronger metal than iron, and if it is manipulated according to the laws of its nature, it will make the most durable gun.

But the long and short of the whole matter is that a thin-walled gun, made of steel or any other metal, supported by a perforated re-enforce, is the principal feature to which we wish to call the attention of the board of ordnance. The Ordnance Depart-

ment seem disposed to accept the failure of Mr. Norman Wiard's test-guns as final; but, after all, is not the fundamental theory of Wiard's correct? Doubtless the manner of applying it in his Trenton gun was erroneous, and I am surprised that he ever consented to its being fired, for most certainly his air-chambers in that gun were no remedy for the defects designed to be corrected, but, on the contrary, were weakening in every particular, and hence the explosion.

We contend that when it is desired to construct large guns there are two points which must be accomplished, and if they are successfully gained the means employed are unimportant; these are strength and durability.

The objection to steel as a gun-metal, "because hitherto no steel gun has been made to certainly sustain large charges," should not prejudice its use in the construction of heavy guns.

The experimental firings had at Pittsburgh with a 15-inch gun seem to be well authenticated.

It would seem difficult, however, to get up and maintain a high degree of temperature in a 15-inch gun with sixty pounds of powder when the external temperature of the air was at 40°. The gun would seem to be too large in caliber to hold it and the amount of powder full small to maintain it any considerable length of time under these circumstances.

The practical inference is that, as the 15-inch gun at Pittsburgh "stood repeated and rapid firings," it will do it under all circumstances.

If a cast-iron gun will endure this pressure, why will not a steel one sustain it? Steel is decidedly superior in point of strength to iron, and why is it that a gun made of it, of the same dimensions, the same weight, the same caliber, the same thickness of wall, will not sustain large charges of powder?

This question has been fully and repeatedly answered in this paper, and it is unnecessary to refer to it again in this connection.

But, referring to the experimental tests at Pittsburgh. While in this instance the gun stood the proof, yet we find nearly all of our ordnance officers still doubting the safety and durability of our heavy ordnance. If our heavy guns are as perfect as the recent experimental firings at Pittsburgh show them to be, why is it that the Chief of Ordnance asked Congress during its session last winter (1871) for an appropriation of two hundred thousand dollars to make a practical test of some new plan to construct better and more efficient large guns? I quote from the report of the Chief of Ordnance for the year 1870, page 9:

"In my opinion it is highly important that the gun should be made and tested; and I earnestly ask that Congress be requested to make the necessary appropriation for this object, of \$200,000.

"The principal nations of Europe, recognizing the great importance of having reliable guns of large caliber, have expended very large sums of money in experiments to determine in what manner and of what material they should be made.

"So important is it to the country that we should at least find out how such guns should be made, (and it can only be done by experiment,) that no sum of money that may be necessary to the end can be too great to be expended for such an object.

"The armaments for the forts must be prepared in time of peace; it will be too late to do it when war comes."

Here is the admission of the head and front of our Ordnance Department, virtually acknowledging the inefficiency of our heavy guns, and that they do not know how nor of what material to make them. There need be no better evidence produced than this to show that our ordnance officers (as well as all others) have no confidence in the heavy guns now in use.

One important question may as well be put to rest here, and that is this: If the unequal expansion of the metal of which a large gun is composed, produced by heat of discharge, does not break it, what does? If not, why not? The uniform pressure of exploding gunpowder is measurable, and so is the strength of metal.

We know that guns of ordinary caliber and thickness of wall are safe and durable, while nearly all rifles larger than 30-pounders are unsafe when served rapidly with elongated shot and heavy charges. Why may not the thick walls of a 10-inch gun be made strong enough to stand the pressure of a proportional charge as well as the thinner walls of an ordinary field-piece? And why has the massing of various metals in divers methods about the chamber left the strongest walls more liable to explode than thinner and weaker ones? And why will not steel make the strongest gun in the world? Our Ordnance Bureau pronounce against it, and say no steel gun has ever been produced to certainly sustain large charges.

But we would (in as modest way as we can) insist that, if the laws governing the strength of steel or any other metal be provided for in a rational manner, it will make the strongest and most efficient gun the world has ever seen.

And now we come to answer the latter part of the objections of the Navy board, and simply say that the objection here made cannot be founded upon practical principles, because all practical experiments and known laws go to prove the rationality and

reasonableness of the plan or remedy herein proposed, and that the objection is entirely theoretical and has not the semblance of the practical about it.

Of course the test as proposed of a 15-inch smooth-bore or a 10-inch rifle will afford ample proof. If the plan proposed should meet the approbation of the examining board, we desire a recommendation to Congress for a suitable appropriation for this object. Should the Government order three test-guns made, and if they should stand the test, the guns would certainly be worth what they cost.

Private individuals have subscribed an amount sufficient to test this plan with two large guns; but before we proceed with their construction we ask the opinion of your board of officers as to the feasibility of our proposed plan for making heavy ordnance, with a recommendation to Congress for an appropriation for this object if it should be approved.

It will be observed, by referring to the cut of our muzzle-loader, that we do not provide conical openings in the wall of our re-enforce the entire length of it. The inventor has conducted some troublesome experiments in order to determine the force of the shot the moment it left the gun, at every point along the barrel. To do this, he resorted to a plan (as proposed by Major Hanscom, the constructor of the steamer Kearsarge) as follows:

Procuring a small field-piece with a thick wall, it was loaded with regulation charges using a spherical shot, firing it against a solid oak target firmly bolted together, each section being in thickness equal to the diameter of the shot, and all backed by a stone wall. The gun was placed within twelve inches of the target and fired, the penetration noted. With a double-acting drill a hole was cut through the wall of the gun down to the powder-bed equal in size to that of the bore of the gun, and at right angles with the plane of bore.

A spherical shot was driven into this vertical chamber even with the plane of bore to the powder-bed. The gun was loaded as before and fired, with a target duly arranged to receive the vertical shot, which was placed twelve inches above the gun and firmly secured, noting the vertical and horizontal penetrations. In like manner were chambers drilled at different points along the barrel of the gun and fired as before, with a note of each penetration, vertical and horizontal.

Finally five shots were weighed—the one-tenth of their weight was the charge of powder put into the gun—four shots having been previously driven into the vertical chambers down even with the bore, the gun being regularly loaded with a spherical shot as before. The gun was fired, and the four vertical penetrations and the one horizontal were severally noted.

By this experiment it was found that the greatest vertical penetration was at or near the trunnions; nearer to the muzzle the vertical penetration was very slight, the shot making only about a quarter-diameter penetration. Consequently we have conformed the wall of our gun (re-enforce) to the line of these vertical penetrations. (see cut, Fig. 1,) and we are inclined to believe that we will hazard very little by making our trial gun after this model.

An account of this experiment, accompanied by a sketch, was sent to the Bureau of Ordnance, Navy Department, care of Captain J. D. Brandt, chief clerk.

Furthermore, in answer to the first part of the objection, concerning a number of "conical holes being drilled into a solid casting, the break of continuity in each circular element weakening the gun, and do not believe the loss of strength is compensated by coring the casting to relieve cooling strains," &c., let us illustrate this by comparing the strength of a solid cast-iron column, weighing say four tons, with one of the same weight and height, cast hollow, of the same iron, possessing the same tenacity. The power possessed by each column to sustain a direct force is greatly in favor of the hollow column.

Will the coring of the casting to form the hollow in this column break the continuity and weaken the casting? Will not this coring relieve the cooling strains thrown upon it? Is it not thereby rendered more efficient and competent to resist a direct force? Or is the continuity so broken as to weaken the casting? Most assuredly not. And is not the re-enforce of our gun composed of apertures substantially the same in principle (in point of strength) as the interval support which would be furnished by a row of columns to support a structure—to resist or sustain a force?

Advantages over the present heavy ordnance.—The gun is furnished with a very thick perforated re-enforce, furnishing an increased radiating surface extending to the very center of the gun, which is intended to prevent the accumulation of heat at a dangerous point, and is provided with a wall constructed upon scientific principles, which it is believed will overcome the expansive force of unequal heating, possessing less porosity, but providing more elasticity, owing to the distribution of apertures in the re-enforce, (distributed in equilateral triangles,) giving about the same amount of metal at every point in the gun, or wall of the re-enforce, where the pressure is found to be greatest. The strongest and best metal is used in the construction of the core or barrel of the gun, and this to be re-enforced by a very tough iron support, provided with ventilations, as above stated. By this arrangement the effect of the silent and insidi-

ous force of heat is controlled, and the gun made to sustain the force of heavy charges and rapid firing superior to that of any large gun that the world has ever seen.

Our breech-loader is practical, and will prove invaluable in the turret of a ship. A practical test will demonstrate this. If there should be any abrasion or deterioration at the vent, the breech-block may be renewed at a trifling expense, which would, in many instances, save a valuable gun to the service.

The ignition of the charge is central, (but is not shown in the cuts;) the powder is ignited at the base of the shot, the explosion is backward, the gases rushing forward, overcoming the inertia of the shot at first, and, in effect, acting upon the projectile with an accelerating force, by which the sudden and violent oscillations are obviated, and must be still greatly lessened by the use of improved powder.

The gun will sustain a charge sufficient to throw solid conical shot as rapidly as it can be served without danger of explosion. If this be true, a ship armed with these guns would sink any iron-clad or other ship of war that now floats, and no fort or harbor defense now in existence could withstand the enormous amount of solid shot that would be hurled against it in such a short space of time. Solid shot, with increased charges, rapidly fired, will batter down the strongest and best constructed defenses known to modern engineering.

At first it would appear that the conical holes in the re-enforce would incline to weaken the casting, but a trial of this, even on a small scale, shows that it does not do it. The continuity seems to be broken, but if the wall is a thick one, it is not broken, for there is a continuous support in one line, angling or zig-zag, and in effect is much like a support furnished by the edge of a piece of timber, compared to its flat or side support.

Our interval support in point of strength is equal to a continuous one, for who has not observed buildings constructed with arched openings (windows and doors) made in a side wall, and it supporting additional stories, with the same security that the entire wall did on the opposite side?

Here we have an interval support illustrated, and a break of continuity shown, but we fail to discover even in this case a point of weakness. But, of course, the citation is not minutely nor strictly applicable to the construction of a large gun, but most certainly is a liberal comparison upon our part in illustrating the capacity of an interval support to sustain a direct force.

When we make a heavy gun, we aim at two points:

First. To provide a wall that will sustain the pressure of the largest charges.

Second. To further provide an avenue for the escape of heat, knowing it to be a silent and insidious agent, which if allowed to remain long at a point within the wall it will break up the fibrous continuity of rigid cohesion. And for this reason we present our perforated re-enforce as a remedy for this defect, and plead for its adoption.

The plan has its disinterested friends; among them are to be found not a few of the brave and honored who have graduated in military and naval schools; men who have become familiar with the artillery service; men who have fought through the fire and blood of rebellion, and by meritorious conduct ascended to the highest pinnacle of fame known among men, by offering their lives for their country's cause.

These men have had ample experience to know the defects in heavy ordnance. And with a patriotic desire to have this important arm improved, they indorse the perforated re-enforce for heavy guns.

For an argument in favor of the principle, as above proposed, we cannot be at a loss to find it at every step. Look at the sides of an iron suspension-bridge; look at the supporting bars, cords, chains, and wires. In this the continuity seems broken, yet it stands the test in proof. Look at the track-bar of a railroad, supported at intervals by cross-ties; this is not a continuous support. The continuity is broken in this, and it would at first seem defective in its office of support. But it is not; it stands in proof.

And, finally, look at this re-enforce gun. It possesses more elements to sustain a force than any solid-walled gun of equal dimensions and weight. It will sustain as much force as any solid-walled gun of equal weight, under hydraulic pressure, and more of the explosive force of powder and the expansive force of heat.

It must be remembered that the perforated re-enforce gun is to be of no less weight than a solid-walled gun; the amount of metal which is taken out of the wall to furnish the apertures must be added to thickness of same. So that a 10-inch solid-walled gun will be no heavier than a perforated one of equal caliber.

Where the apex of the cone-shaped aperture, or opening, (in the re-enforce,) comes in contact with the barrel or core of the gun, the latter is supported by a circular arch, and thus we have an interval support; and a test will show it to be of more practical utility than a continuous one.

I have said that this gun will sustain larger charges and heavier projectiles, under continuous fire, than any solid-walled gun of equal weight, simply because the gun is constructed so that the heat from discharge cannot exert any force, (beyond that which we may reasonably expect to be provided for by the compressibility of the metal in the wall of the gun;) the power exerted by it is obviated by an avenue for its harmless

escape. Besides this, we have a wall of great strength and thickness, superior to that of any solid-walled gun now in use.

History of the invention.—About the year 1843 the inventor obtained the description of a large wrought-iron cannon, in which he took quite an interest. The gun was placed on board of the United States steamship Princeton, under command of Commodore Stockton. The steamship was returning from an excursion down the Potomac, having President Tyler, with his Secretaries and their families, and several members of Congress, on board. By the bursting of this gun both the Secretaries of State and Navy were killed, and quite a number wounded, some of them mortally.

The inventor, having a natural taste for mechanics and for the investigation of physical science, was incited to take up this question and investigate the failure of the big gun above referred to. From the most comprehensive data he derived the theory that the rapid firing of a thick-walled gun must produce a degree of heat sufficient to cause unequal expansion in the mass of metal, and thus create cracks, or, at least, strains, sufficient to produce rupture when re-enforced by the pressure of a subsequent discharge. No gun in use was so constructed as to be guarded against the silent power of this insidious agent. The inventor believed that, with the requisite strength of wall, durability could be attained only by providing for the harmless escape of this great volcanic force. He made a small model, consisting of a comparatively thin barrel, surrounded by a thick but perforated re-enforce, and exhibited it at the Department in the year 1852; but his theory was regarded as paradoxical, and no attention was paid to it. It appeared to the inventor that constructors were as intent upon securing strength of wall, initial tension, &c., as if they were constructing cylinders for hydraulic presses instead of cannon.

The inventor quietly awaited the failure of nearly every plan to produce a reliable gun of large caliber. A few guns seemed to stand the test, but the majority of them were regarded with much suspicion. In the mean time, he had the satisfaction to find his theory gaining ground among the practical mechanics of the country. At length, in 1865, it was revived in a memorial to Congress by Norman Wiard, a skillful mechanic, who proposed a new plan of construction, intended to obviate the effects of heat. Mr. Wiard's gun, however, notwithstanding the correctness of the inventor's fundamental theory, did not escape the action of the destroying force, but failed from the same cause that, by various exertions of its power, has defeated the hopes of others. In 1868 the inventor again exhibited his model in Washington. He obtained a patent, and took steps to secure his rights as inventor in Europe.

Since which time a joint-stock company has been organizing under the general incorporation act of the District of Columbia, in the name of the "Terrell Heavy Ordnance Company," for the purpose of manufacturing heavy ordnance for forts, harbor and coast defense, ships of war, &c., under patents granted to John A. Terrell by the Government of the United States, with such improvements in said inventions as may from time to time be made. The duration of said corporation is limited to twenty years, and its capital stock is to be \$100,000. This company proposes, first, to have trial-guns made and fully tested. The inventor deems it proper and right, before proceeding with the organization of this company further, that the Ordnance Department be requested to take this subject up and investigate the utility and feasibility of the plan as herein proposed; that if they should believe, after such careful investigation, that the perforated re-enforce for large guns promises any favorable results, that they will so recommend the same in a report to the Chief of Ordnance, or otherwise, so that Congress may be memorialized to make a suitable appropriation to make and test three or more heavy guns upon this plan.

I am, sir, very respectfully, your obedient servant,

JOHN A. TERRELL.

General A. B. DYER,
Chief of Ordnance, Washington, D. C.
JULY, 1872.

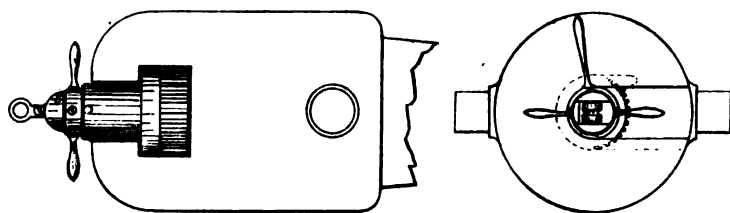
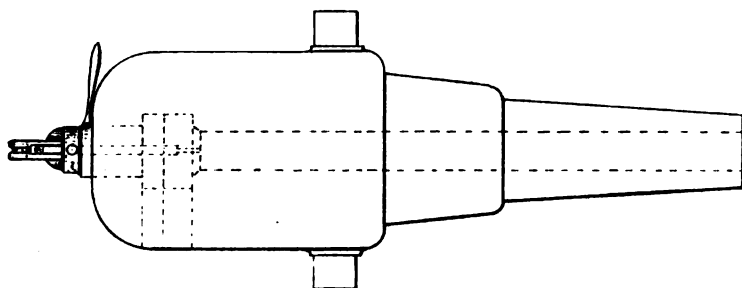
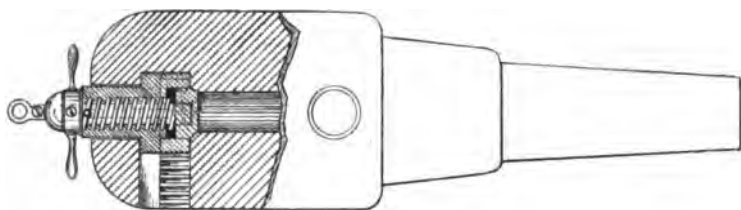
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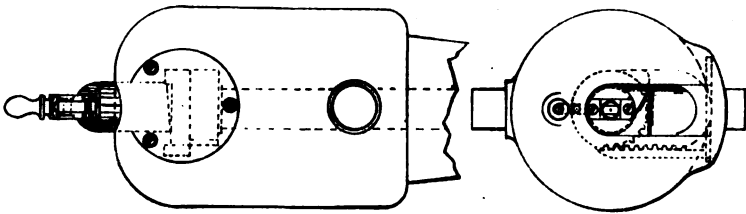
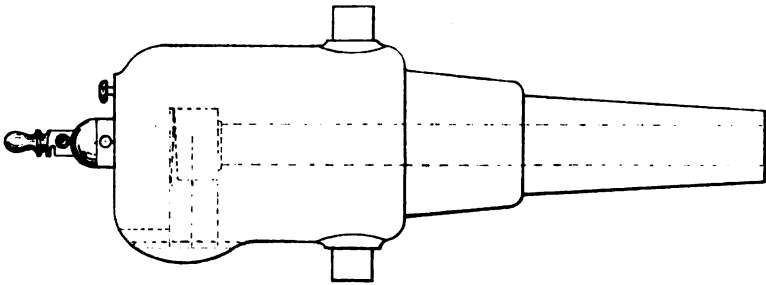
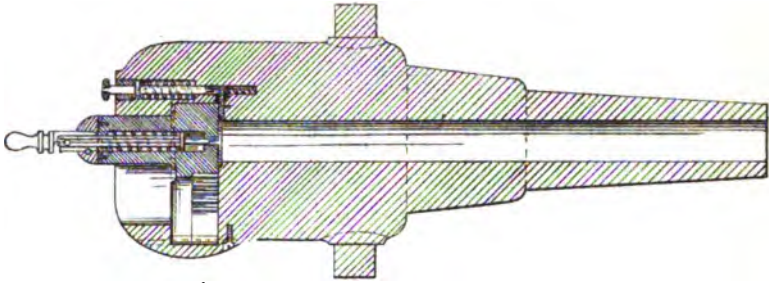
BROOKLYN POST-OFFICE, New York, July 10, 1872.

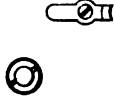
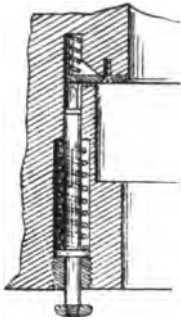
GENTLEMEN: I desire to inform you that I am the inventor of a system of breech-loading gun, which has been laid before prominent officers of the Army and Navy of the United States, and has elicited from them the most favorable opinions as to its merits; the evidence of which will be laid before you, together with some argument relating to its peculiar advantages. It was also exhibited in Washington to prominent and intelligent Senators and members of Congress, invariably receiving the highest commendation, and was referred to by the Hon. John A. Logan, of the Military Committee in the Senate, and the Hon. O. J. Dickey, of the Appropriation Committee in the

THOMPSON'S Breech Loading GUN.



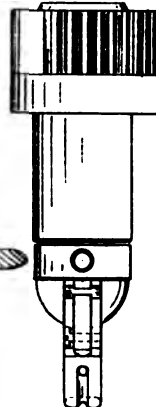
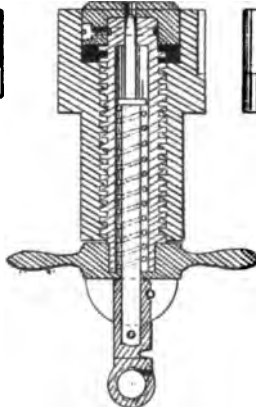
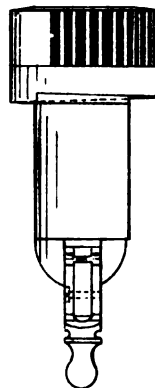
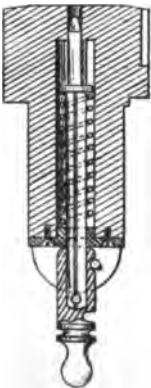
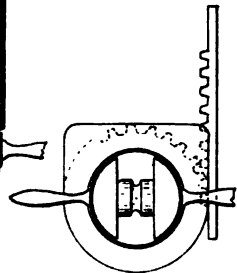
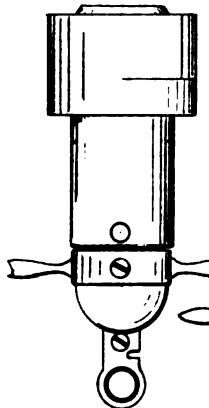
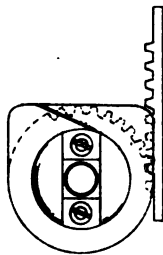
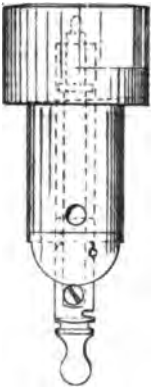
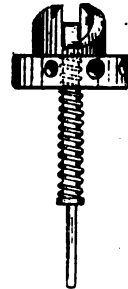
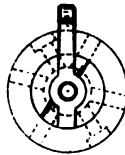
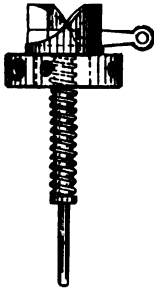
THOMPSON'S Breech Loading GUNS.



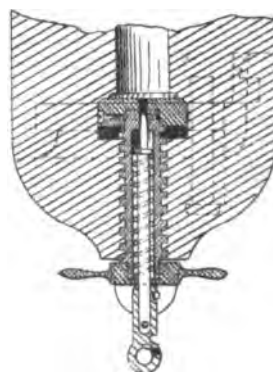
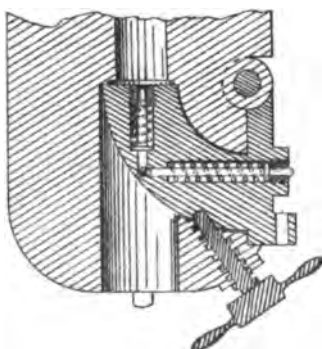
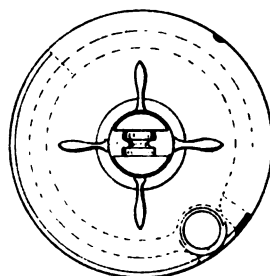
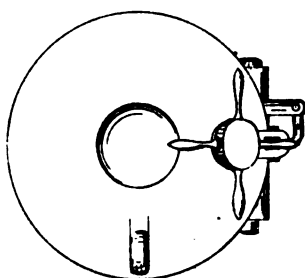
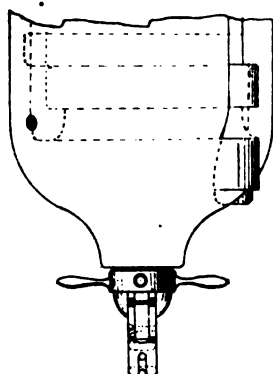
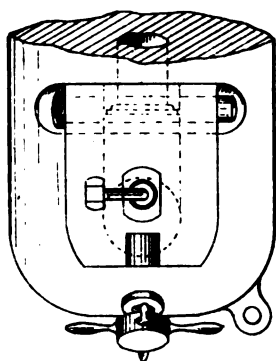


THOMPSON'S

Breech Loading GUN.



THOMPSON'S Breech Loading GUNS.





House of Representatives, while advocating the passage of the bill making appropriations for three heavy rifled guns, part of which number were to be breech-loaders, during the last session of Congress, and that the two plans of breech-loading which I lay before you herewith for consideration were both laid before the aforesaid committee, and, being highly approved by them, instigated the amendment to the bill providing for the trial of guns to be loaded at the breech, according to the appropriation bill, under the terms of which you have been appointed. I accordingly propose to manufacture and deliver to the United States two several and different breech-loading guns, each of the caliber of 12 inches and weight of 70,000 pounds, as near as may be obtained conveniently by estimates of weight in advance, but not to deviate from that weight more or less to a greater extent than 1,000 pounds in either gun. These guns are each to be so constructed as to give reasonable hope that they will withstand 500 rounds or more with charges of 100 pounds of powder, and with rifled projectiles of 600 pounds weight; and all the records of their fabrication will be so preserved, and all the special appliances will be so carefully constructed and retained for future use, as to enable me to offer duplicates of either or both guns, of uniform quality, to the War Department if their endurance under extreme proof should render it desirable for the Government to procure more of the same kind, when the guns wanted may be furnished for reasonable and greatly reduced prices as compared with the cost of the trial guns; first guns of new and special kinds being always necessarily expensive almost beyond computation to even the most experienced foundries.

The first of the two guns I propose to fabricate, while having the weight before referred to, will be similar in model, manner of construction, and material to the English 35-ton gun, viz, the body of the gun will be made in three principal parts, consisting of a re-enforce part bearing the trunnions, the breech-block and gas-check extractor, the whole of the best quality of wrought-iron, made up with rings, all the welding surfaces of which will be turned faces and fitted to each other before the welding heat is applied, and during the final cooling the interior cooling will be hastened and the exterior surface cooling retarded. The second part, forming the chase of the gun, will also be of the best wrought iron, coiled and welded. It will be inserted for a depth of 12 inches, with screw-threads within the forward part of the re-enforce; thus the re-enforce and the chase will form the exterior body of the gun, and will be firmly formed to each other independently of the steel lining—to be described—which forms the third principal part of the gun, and entirely forms the interior or bore, from the muzzle to the abutment of the breech-block. The lining will be made of low ductile steel, tempered in oil. It will be cylindrical in form and parallel for its whole length, except at its rear end, where, for 12 inches of its length, it will be fitted with screw-threads within the principal re-enforce part of the gun. The chase-coil will first be shrunk upon the steel lining in its proper position with moderate tension. The screw-threads will then be formed upon the rear end of the chase upon its exterior and also upon the breech end of the steel lining, when both will be inserted into their seats, the steel tube being only fitted loosely within the re-enforce part forward of the screw-threads.

The steel lining being at this period of the process bored to less than its final and finished caliber, three heavy enlarging charges will then be fired from the gun to expand the steel lining within the re-enforce with the proper degree of tension, after which the gun will be bored to the proper caliber, 12 inches, rifled, and furnished with its breech-block and gas-check extractor, and be ready for delivering.

The second gun, also of caliber of 12 inches, and rifled, will be made of cast iron of the most approved quality. Its body will be cast hollow, and be cooled from the interior, and will have a steel lining similar in all respects to that of gun No. 1—the first described—fixed in its position at its rear end within the re-enforce part of the body of the gun by 12 inches in length of screw-threads, and the lining-tube will be enlarged to give it the proper tension within the body of the gun in the same manner by enlarging charges, fired from it before the final boring to fix the caliber.

The form and kind of breech-block, and the manner of operating the same in both guns, will be shown by the models of each, which will be laid before the board whenever desired. Drawings also will be shown which will explain the details more fully.

As to the rifling, I prefer that the board shall determine what system shall be adopted, and what kind of projectile shall be used. I have been informed that some experiments are being conducted at South Boston for the Navy which may exhibit important results, and as the experiments referred to may soon be completed, I prefer that the manner of rifling shall not be fixed at present, and I agree that I will rifle either or both of these guns if they are ordered of me, as directed by the Ordnance Department, after they are completed otherwise.

I am now busily engaged in the preparation of exact drawings and specifications for both the above-described guns, copies of which, together with models, will be furnished to the Ordnance Department, to be referred to in the contract for making either or both of these guns, should the contract be awarded to me by the War Department, upon the receipt of your report.

I am willing to enter into contract for the manufacture of the first gun above

scribed for the price of \$140,000, and I am willing to enter into contract for the manufacture of the second or last described gun, for the price of \$80,000, and hold myself ready to give ample security to the War Department for the faithful fulfillment of the contracts or contract.

NATHAN THOMPSON.

THE ORDNANCE BOARD ON HEAVY RIFLED ORDNANCE.

[No. 42.]

UNITED STATES ARMY BUILDING,
New York, July 26, 1872.

SIR: I am directed by the board on heavy cannon to inform you that the board has adjourned to August 7, by which date it is expected that all matter for its action will be before it.

Very respectfully, sir,

C. E. DUTTON,
First Lieutenant, Ordnance, Recorder.

NATHAN THOMPSON, Esq.

[No. 96.]

BROOKLYN, August 19, 1872.

GENTLEMEN: Returning, I find your esteemed communication of 16th.

It will afford me pleasure to meet you on Thursday, 22d instant, the earliest day I can appoint with my present commitments, at, say 1 o'clock p. m., to confer with you on the matter indicated.

Very respectfully, your obedient servant,

NATHAN THOMPSON,
By G. H. JENNING.

THE BOARD ON HEAVY ORDNANCE,
Army Building, 146 Greene Street, New York.

[No. 78.]

The Thompson system of breech-loading ordnance.

Inaugurates safety, rapid fire, and great economy in working-force. In these days of turrets and iron-plate armor, it is important that one gun should do the work of many, i. e., number of shots by rapid fire, take the place of number of guns. Casemates and turrets being too circumscribed to handle "muzzle-loaders" to advantage. My system requires but few men, places them behind the gun, which acts as a "port-stopper," instead of near the embrasure, where most danger lies. It removes danger from premature explosion, no fire being left in the gun after previous discharge, as in case of muzzle-loaders. Breech-loaders have been largely approved and adopted in Europe. It is only that so many large guns of this description have burst that muzzle-loaders are retained in England. This liability to burst is obviated by my system, and makes one gun equal to four by delivering at least four shots where but one is possible under previous systems. It includes more than four distinct inventions, differing from all systems hitherto offered on either continent, and is seen in its most approved form in Nos. 4 and 5. In No. 5 a breech-block of one piece, with steel ejector, lock, and firing-pin attachment, which last, however, may be replaced by old-style vent if desired, includes all its parts. Its operation requires only that the lock be set to withdraw the firing-pin, and then roll the breech-block, so arranged as to be nearly equipoised toward the right when the gun is open to receive the charge; a gas-check of papier-mache, copper, or brass is inserted behind each charge as in other systems, when the breech-block is rolled home, and the gun is ready for discharge.

Gun No. 4 is similar to the above, except that the gas-check is dispensed with, the breech-block being forced forward to close the joint by a powerful screw working through the block, and the operation of closing and opening the breech is the same as in No. 5, except that the screw is withdrawn before the block is rolled aside to insert the charge.

I saw fit to retire gun No. 2, and the construction and operation of guns Nos. 1 and 3 are so obvious from the models shown, that minute description is hardly necessary.

I claim for my guns every merit offered by other systems, and, in addition, rapid fire, safety to men from closed ports, cleaning without scrubbing, and reduction of working force, as, by the arrangement of the breech-block in Nos. 4 and 5, one man can move the heaviest breech. Another advantage of vital importance must not be overlooked. There is no vent or passage through the breech-block or re-enforce for ignition of the

charge; consequently no passage for hot gases through the parts, and no unequal heating. This prevents unequal expansion, insuring safety to such parts and protection to the breech-block, which often becomes set from this cause, and thus useless for hours, a disaster which in time of battle might lose the day.

The removal of the breech-block effectually spikes the gun; it is then useless to the enemy, and guns thus abandoned may be reclaimed at convenience.

In conclusion, my system has commended itself and received complete recognition from members of the Cabinet and other high officials of our Government, as attested by certificates in my possession, to which are attached seals of their various departments, as also from experts and many officers high in rank in both Army and Navy.

My wish is to place our nation on equal footing with any and every first-class power, and fairly and thoroughly test a system promising so many advantages.

NATHAN THOMPSON.

BROOKLYN, *August 3, 1872.*

Letter-book No. 53.]

ARMY BUILDINGS, 146 GREENE STREET,
New York, August 16, 1872.

SIR: Referring to your proposition now before the board for the construction of heavy ordnance, I am directed by the board to request you to name a date at which you can appear before it to afford some additional information in relation to your plans.

It is requested that you will name as early a day in the ensuing week as possible.

Requesting an immediate reply, I am, sir, very respectfully, your obedient servant,
C. E. DUTTON,

First Lieutenant of Ordnance, Recorder.

N. THOMPSON, Esq.,
Brooklyn Post-Office, Brooklyn, Long Island.

No. 104.]

NEW YORK, *August 23, 1872.*

GENTLEMEN: 1. Referring to my proposal to construct a gun on my system, I think after the first gun is made I can furnish the one at specified price of \$80,000, in lots of ten or more for, say, \$35,000 each, perhaps less.

2. Mostly all guns of heavy caliber have proved worthless in service, which is demonstrated by evidences at navy-yards at Washington and elsewhere.

3. The price of cast-iron guns, as constructed at present, cannot be taken as criterion for guns that will stand the wear and tear of service.

4. The object of this appropriation, I have every reason to think, was to test such system as promised most effectually to obviate this difficulty, which difficulty I propose to meet and overcome.

5. Inasmuch as the Government has spent millions and obtained nothing thus far, if my gun meets the necessity, it will certainly prove economical at the price named.

Should the trial-guns be adapted to receive the breech-blocks of guns No. 4 and 5, the cost will be increased by \$10,000, the trial-gun then costing the sum of \$90,000.

NATHAN THOMPSON.

THE BOARD ON 12-INCH HEAVY ORDNANCE.

J. VAVASSEUR & CO.

No. 52.]

OFFICE OF HERMANN BOKER & CO.,
101 AND 103 DUANE, AND 91 AND 93 THOMAS STREETS,
New York, July 19, 1872.

COLONEL: We herewith beg to hand you * * * a letter, (marked F,) dated London, July 4, 1872, from Messrs. J. Vavasseur & Co., to Messrs. Horstman & Co., with estimate (marked G) and drawing for 12-inch caliber rifled steel gun.

We also inclose Naval and Military Gazette, issue January 20, 1872, which contains a full description of the Blakeley-Vavasseur system of heavy ordnance. We expect specifications from the Bochum Mining and Cast-steel Manufacturing Company for 12-inch caliber cast-steel rifled muzzle-loaders, as before reported from telegraphic answer, in a few days,

And remain, yours, very respectfully,

HERMANN BOKER & CO.

Colonel S. CRISPIN,
Major of Ordnance, Greene and Houston Streets, City.

[Indorsement.]

UNITED STATES ORDNANCE AGENCY,
New York, July 23, 1872.

Respectfully referred, together with its inclosures, to the board on heavy ordnance, convened by General Orders No. 57, dated June 28, 1872.

S. CRISPIN,
Brevet Colonel U. S. A., Major of Ordnance.

[Inclosure F.]

LONDON ORDNANCE WORKS, BEAR LANE, SOUTHWARK,
London, S. E., July 4, 1872.

GENTLEMEN: Inclosed we hand you estimate and drawing of a 12-inch cast-steel rifled gun, which we have so near completion that we could deliver it for proof in from six weeks to two months from date of order. This gun is made entirely of Messrs. Thomas Firth & Sons' cast steel, the inner tube being oil-tempered. The gun to be proved at the Royal Arsenal, Woolwich, at the cost of the purchasers, and at our risk.

With respect to a 12-inch breech-loading gun, we can hardly quote you definitely, as there would be some difficulty in getting Messrs. Firth to undertake the necessary steel forgings. The price of such a gun would be about £7,000, and we should require some nine months for its manufacture. The weight of this gun would be about 28 tons.

Your obedient servants,

J. VAVASSEUR & CO.

Messrs. HORSTMAN & Co.,
2 Crosby Square, London.

[Inclosure G.]

LONDON ORDNANCE WORKS, BEAR LANE, SOUTHWARK STREET,
London, S. E., July 4, 1872.

	s.	s.	d.
Estimate for one 12-inch built-up cast-steel rifled gun, sighted and vented complete	4,725	0	0
Diameter of bore, 12 inches.			
Length of bore, 187 inches.			
Weight of gun, 26 tons.			
Weight of projectile, 600 pounds.			
Charge of powder, 110 pounds.			
Casemate carriage and slide for above gun	1,300	0	0
Projectiles:			
Common shell, each	6	0	0
Projectiles for use against armor-plates:			
Shot, each	7	10	0
Shell, each	11	10	0

The above prices are exclusive of proof of gun and packing charges.

J. VAVASSEUR & CO.

Messrs. HORSTMAN & Co.,
2 Crosby Square, London.

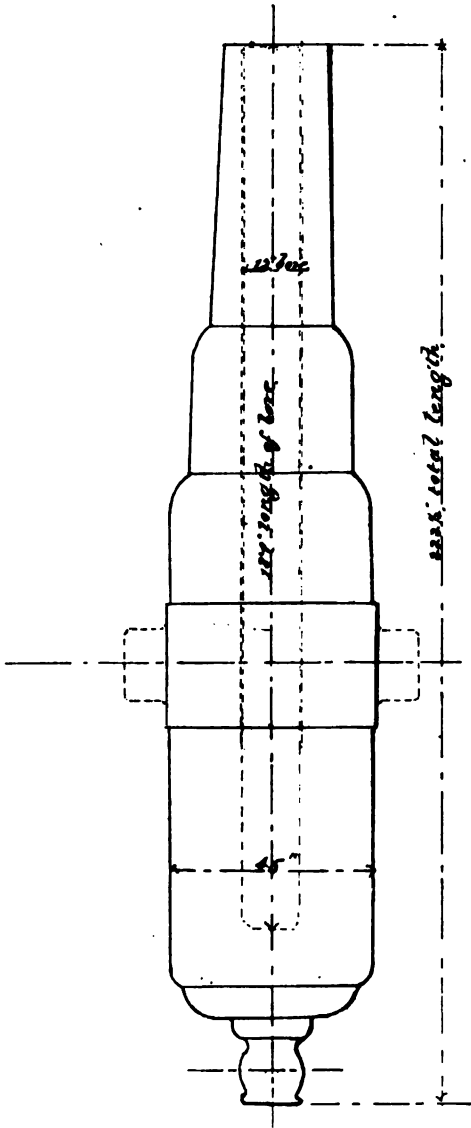
[Extract.]

THE BLAKELEY-VAVASSEUR GUN.

These fine steel guns are manufactured by Messrs. J. Vavasseur & Co., London Ordnance Works, Southwark street, London, southeast. The guns, from 7-inch caliber and upward, are manufactured entirely from mill cast steel, except the trunnions, which

(H.)
**12 INCH MUZZLE-LOADING
 RIFLED STEEL GUN.**

Weight, 26.3 tons.



*J. V. Vaseur & Co
 London Ordnance Works,
 Southwark St. London, S.E.*



are of wrought iron. The inner tube, A, of the gun is first rough-bored and turned to within 2 to 3-10ths of an inch of the finished dimensions; it is then oil-tempered. The apparatus for oil-tempering consists of a vertical furnace for heating the tubes; at convenient distances round the exterior are arranged draught-holes; these holes can be opened or closed at will as the heat of the tube may require it, the fuel employed for heating the tube being wood.

At a few yards from this furnace is placed the oil-tank, the top of this tank being level with the top of the furnace for heating the tubes. This tank is supplied with an exterior water-tight casing, and when in use water is kept circulating between the exterior of the tank and the interior of the casing. The oil-tank is also supplied with a pair of close-fitting iron doors or covers, with a hole in the center only large enough to admit the chain carrying the tube. These doors are closed immediately after the tube is immersed, so as to at once smother the flame from the oil, should it be fired by the tube when it is being introduced. A crane is arranged over the furnace and tank in such a manner that the gun can be plunged into the oil-tank, with the least possible delay, when heated sufficiently. The gun-tube is placed vertically in the furnace for heating, and is also plunged vertically into the oil-tank, and as rapidly as possible. The effect of this oil-tempering is to double the elastic limit of the steel, as will be shown by the tables attached hereto, and also to render it much more uniform.

The tube, after being oil-tempered, is turned on the exterior, and fitted or adjusted to the jacket B, the proper difference being allowed for the shrinking. To adjust this shrinkage as accurately as possible, the jacket B, after being bored to the required dimensions, is gauged every 2 to 12 inches of its own length, according to its size; and the tube is also divided longitudinally into corresponding divisions, and each point of the tube is adjusted to the corresponding part of the jacket, the desired amount of difference for shrinkage being allowed between the internal diameter of the jacket and the external diameter of the tube.

The jacket is then placed over a pit, and a temporary furnace constructed around it by means of loose fire-bricks, arranged so as to leave draught-holes, in order that, by closing or opening these holes, the jacket can be equally heated to the desired temperature; the jacket being placed over a pit, and the hole at the bottom of the jacket being kept open, the workman can, by descending into the pit, and looking up through the inside of the jacket, readily ascertain when it is sufficiently heated, and also whether it is being heated equally all over.

When the jacket is sufficiently hot, the fire is cleared from the top, and a plate covering the open end of the jacket is removed, and the tube, being previously suspended by means of a crane over the jacket, is lowered as rapidly as possible into its place; the fire is then smothered by means of sand or ashes, and the whole allowed to remain till cool.

The front hoops are next put on; the gun is then put into the lathe, and turned and adjusted to receive the trunnions, the rear hoops, and the front hoops. These are put on in the same manner as above described, and the gun is completed on the outside to the desired dimensions; then fine-bored and rifled. It will be noticed that the tube A is solid at the breech end, and also that it rests at the breech-end against a shoulder on the inside of the jacket B, while a corresponding shoulder at the other end of the jacket fits into a recess on the trunnion; this construction renders any movement longitudinally impossible without previous rupture of the metal, and provides amply for the longitudinal strength of the gun.

The outer tier or tiers of hoops or rings are preferred in short lengths of 6 to 8 inches, for the following reasons:

These rings are comparatively small pieces of steel, so that they can be well worked under the hammer, and in the rolling-mill, being thus far more reliable than if made in one length, sufficient to reach from the trunnion to the breech.

Defects existing in the metal can be more readily detected.

They can be more readily and exactly adjusted to the outside of the gun, and they are considerably cheaper than if made in one piece. The rifling, on the rib system, is a modification of the plan introduced by Lynam Thomas some ten years ago.

It appears to possess the following advantages over the groove system: It provides for the accurate centering of the projectile; three ribs only are used with guns of all sizes, from 3 to 12 inch bore; the driving sides or edges of these ribs being radial, the projectile, if bearing or touching on these three ribs, must be centered, presuming, of course, that the projectile is rifled in a machine, and accurately divided.

The tube of the gun is not weakened by having the grooves cut into it; the ribs projecting into the bore strengthen it. The area of the bore in a 12-inch gun rifled on the Woolwich system is 116.07 square inches; on the rib system, 111.7 square inches, or 3.37 square inches of metal in favor of the rib-rifling.

The ribs projecting in the bore are more perfectly cleaned by sponging than are grooves.

The projectile has the following advantages: It is considerably cheaper, as no studs are required, and no holes have to be drilled and countersunk for fixing them.

There are no studs projecting from the projectiles, and they cannot get injured in transit if fairly used, and no packing of any sort is necessary.

The bearing surface for turning the projectile is seven or eight times greater than in a studded projectile, where a gaining twist is used, and consequently only one row of studs; each stud has a bearing surface about 1 inch long; as there are nine studs in the Woolwich gun, this gives a bearing surface 9 inches long for turning or twisting the projectile; in a Vavasseur projectile, with three grooves running the whole length of the parallel part, the bearing surface on each is 20 inches to 24 inches long, according to the nature of the projectile; three times this gives a total of 60 inches to 72 inches of bearing surfaces.

Any required pitch of rifling can be given without injury to the gun, or fear that the projectile will not follow the rifling.

One angle has been adopted for guns of all calibers; this angle is about equal to one turn in 30 calibers. Excellent results have been obtained in a 12-pounder field-gun of 3-inch bore, in a 7-inch gun of 5 tons, and the principle is to be still further tested in a 12-inch gun of 28 tons, now in course of construction.

This 12-inch gun was designed in the early part of last year, and the steel for the different parts was delivered about June or July, 1870; other work more pressing has obliged this gun to be put for some time aside. On referring to the engraving, it will be seen that the bore is 12 inches, that the gun is nearly 16 calibers long, and that the weight of the projectile is to be 600 pounds, with a charge of 110 pounds of powder.

The advantages of steel as a material for the construction of heavy guns are so great, that it is difficult to understand why it is not more extensively employed. Heavy guns have to resist such great and sudden strains that homogeneity of structure must be of the highest importance; the pressure of gas produced by the combustion of large charges of powder is so great, that it seems folly not to select for the construction of guns from all the metals at our command the one which has by far the greatest tensile strain and elasticity.

To combine in the structure of a gun so highly elastic a material as oil-tempered steel with so ductile a material as wrought iron, seems to be wrong in principle, especially when we consider that in a gun the ductile material is outside the elastic and the explosive force is applied from within.

Surrounding the steel tube of a large gun with wrought iron may be a good plan to prevent the gun from bursting explosively, (but experience shows that this is not always the case,) but it certainly appears to have the disadvantage of limiting the number of rounds the gun will sustain, the wrought iron being too ductile to properly support the steel tube. This is proved most conclusively by the failure of the 9-inch Armstrong guns in Prussia and Austria in 1868 and 1870. The first gun failed through the steel tube cracking at the 232d round, and the second gun from the same cause at the 111th round, (notwithstanding that in Austria the prismatic powder was used;) and still further by the cracking (at the muzzle) of the steel tube of a 10-inch 18-ton Fraser construction gun on board Her Majesty's ship *Hercules*, through the premature explosion of a shell near the muzzle of the gun.

The charge so often and so strongly urged against steel guns that they burst explosively is hardly borne out by practice. Steel guns that have been burst have almost invariably been solid steel guns, a plan of construction that has been, at all events as far as large guns are concerned, the exclusive practice of Krupp. Since the necessity of building up guns has been forced on this eminent maker, no large guns have burst, the recent accident in Russia being to the unhooped muzzle portion of an 11-inch gun. It is, therefore, an open question as to whether they will burst explosively or not; what experience there is on this question goes to show that they will fail, as theory says they should, from the outside, and this opinion is strengthened by the following facts:

On January 26, 1864, a 9-inch steel Blakeley gun was submitted to proof at Woolwich; the charge was 45 pounds of R. L. G. powder, and a projectile of 360 pounds weight. At the first round one of the exterior hoops cracked; notwithstanding this, the charge was, at the late Captain Blakeley's request, increased to 50 pounds, and another round fired without any injury to the gun. The authorities at Woolwich, however, declined to give a certificate of proof with the gun, so the hoop was replaced by another, and the gun again submitted to proof on April 30, 1864, when it was fired successfully two rounds with charges of 50 pounds, and projectiles weighing 360 pounds. On April 29, 1864, another 9-inch Blakeley built-up steel gun was submitted to proof. At the second round the trunnion, which was of cast iron, cracked; this was replaced, and the gun again submitted to proof in December, 1866, when it passed.

In December, 1866, another 9-inch built-up steel gun was submitted to proof, (one of a batch of 8 guns;) one of the exterior hoops cracked; this was replaced by another hoop, and the gun again submitted to proof in January, 1867, when it passed. The Parsons 8-inch gun, made at these works, is also a further instance that steel guns do not burst explosively—this gun failed from the outside, as all properly-constructed

guns should do. These guns, it must be remembered, were all fired with the strong R. L. G. powder, now abandoned as too brutal and destructive for Armstrong guns. In this last instance the cast-iron outer case cracked, the steel tube remaining uninjured.

Built-up steel guns can be made very much lighter and equally strong with the guns now in use in the English service; this saving in the material will make the guns not more costly than guns of corresponding sizes, constructed on the Armstrong system, while there remains the advantage of a handier gun.

The 11-inch built-up Blakeley guns now at Callao weigh only 14 tons, yet these guns were proved at Woolwich with charges of 60 pounds of powder, and projectiles of 480 pounds weight. These guns were used against the Spanish fleet in 1866, and were fired a considerable number of rounds, some of them over 50 per gun.

The 9-inch Blakeley guns, also at Callao, though only of 8 tons weight, were proved with charges of 45 pounds, and projectiles of 240 pounds weight. None of these guns, 15 in all, sustained the slightest injury; although the tubes were not oil-tempered, and the strongest R. L. G. powder was used.—*Naval and Military Gazette*, January 20, 1872.

NORMAN WIARD.

No. 2.]

48 BROAD STREET, NEW YORK, July 8, 1872.

SIR: I forward you herewith a proposition to "the ordnance board on heavy rifled ordnance," together with a printed letter referred to in my proposition, both of which I will ask you to lay before the board.

Believe me, very respectfully,

NORMAN WIARD.

S. CRISPIN,

Brevet Colonel, U. S. A., Major of Ordnance.

[Indorsement.]

UNITED STATES ORDNANCE AGENCY,
New York, July 10, 1872.

Respectfully referred, together with its inclosures, to the board on heavy ordnance convened by General Orders No. 57, dated June 28, 1872.

S. CRISPIN,

Brevet-Colonel, U. S. A., Major of Ordnance.

Combined rifle and smooth bore guns—an improvement in heavy ordnance. By Norman Wiard; contained in a letter to the Secretary of the Navy, and official documents.

NEW YORK, March 16, 1872.

SIR: By the demise of General Rodman and Admiral Dahlgren, both the War and Navy Departments are deprived of the genius to invent, and skill to execute, improvements in ordnance among their officials.

Previous to the death of these distinguished officers, each of them placed their opinions on record as to the state of the art of fabricating rifle-guns, to the effect that neither the United States authorities, nor the ordnance service of any other country, possessed a system of rifle-guns which could be relied upon for uniform endurance.

At a late date, Admiral Dahlgren expressed himself to a committee of Congress in these words:

"I think the whole question of rifle-guns is open. I do not think that anything is known about it, either in wrought or cast iron. I know of nothing in foreign countries in which I believe they have really reached better results than we have here."

The admiral, who was at the time Chief of the Bureau of Ordnance, was then asked the following questions, and gave the answers shown. (See Report of the Joint Committee on Ordnance; Rep. Com. No. 266, 40th Congress, 3d session.)

"Question. Have experiments in this country demonstrated as yet that large rifled guns can be made, according to the Rodman system, with a reasonable certainty of endurance?"

"Answer. I think not.

"Ques. How will it compare with the solid mode of casting?"

"Ans. The solid mode of casting has given no better results with rifled cannon than the hollow.

"Ques. Are not the Parrott rifles condemned by the board of ordnance officers?"

"Ans. The 150-pounders were recommended to be withdrawn by a board. The Bureau also reduced the charge for the 100-pounders.

"Ques. If the condemnation extended to all guns made by Captain Parrott, why have they been retained in service?

"Ans. It did not extend to 100-pounders or to rifled guns of less caliber.

"Ques. Do you think the 100-pounders reliable guns?

"Ans. I should be apt to handle them very carefully.

"Ques. Have any Parrott guns burst recently in the naval service since the war?

"A rifle gun, 30-pounder, burst recently in the South Pacific squadron, which I just left. I don't think the number of rounds had amounted to 200. I reported it to the Secretary of the Navy, and told him we had no rifled guns in the Navy that were reliable, asking leave to proceed to investigate the question, and ascertain if reliable rifle guns could be procured."

General Rodman also said to the same committee:

"My belief is, that no nation has yet decided definitely upon which is the best material for rifle guns."

Upon hearing this and other testimony of like character, the Joint Committee on Ordnance, composed of three prominent Senators, and three members of Congress of well-known ability, in their report said—referring to the exclusiveness of the Ordnance Departments, and their aversion to the interference of outside inventors: "In the second place, these officers come to look upon themselves as possessing all the knowledge extant upon the subject of ordnance, and regard citizen inventors and mechanics, who offer improvements in arms, as ignorant and designing persons, and pretentious innovators, who have no claim to consideration. Instead of encouraging the inventive talent of the country, these officers have constantly discouraged it, and many complaints of improper and oppressive treatment have been laid before the committee by persons who have sought to draw the attention of the authorities to what were supposed to be 'vital principles connected with their art.'"

The report continues:

"The investigations of the committee lead them to the following conclusions:

"1st. That no more heavy guns should be purchased for mounting in the fortifications or on shipboard until such improvements are made in methods of fabrication as will insure more reliable endurance than has heretofore been exhibited;" and also recommended—

"4th. That experiments should be at once conducted for the purpose of ascertaining the real cause of the bursting of heavy guns, and of determining upon some method of fabrication that will secure uniform endurance.

"5th. That every encouragement should be given to inventors, and a full and fair trial accorded to devices offered to the Government that promise a solution of the ordnance problem."

The result of the long and patient inquiry by the committee, as shown in the report, (Rep. Com. No. 266, 40th Congress, 2d session,) the loss of the valuable services of Admiral Dahlgren, together with popular belief that the heavy guns, used during the late war—the only guns with which our ships of war and fortifications are yet armed—did not exhibit the endurance expected of them—a distrust justified by the list of guns which burst in service while in battle, published in the report of the committee before referred to—creates a feeling of insecurity throughout the country, when possible complications with foreign nations "loom up" in the future; and would seem to justify, or make it imperative, that earnest attention and careful consideration should be given to the subject at this time, as well as out of deference to the recommendations of the committee which prosecuted the inquiry laboriously for many months.

It would also seem proper for the Department to make at least one attempt to solve the "ordnance problem," by experiments conducted in a different manner from all those which have been heretofore essayed, and to give patronage to those inventors and those inventions which seemed to the committee to promise the most valuable results; especially as neither ordnance department has at this time any officer who has exhibited any marked ability as an inventor of guns, or manipulator of metals, since the loss of the services of the distinguished officers before referred to.

As I have frequently assured you, and as you were assured by my friend, the Hon. Robert C. Schenck, on the occasion of a visit we made to you just previous to his departure for London, I have invented what I conceive to be an important system for the improvement of heavy guns, such as are now mounted on the iron-clads and other ships of war of the Navy, and in the fortifications of the United States, by which smooth-bore guns may be converted into rifle-guns at small cost, without even dismounting them from their carriages; and by which such rifle-guns as are possessed by the Government may be made to have greatly increased efficiency, endurance, penetration of iron plates, higher initial velocity to the shot, much longer range, and greatly improved precision; while the guns, if smooth-bore, will remain essentially as good, or be better smooth-bore guns than they are now; and, if they are rifled, they may be, after the improvement is applied, used effectively as smooth-bores, if desired.

By this means all the spherical projectiles now on hand may be utilized, and all carriages, pivots, implements, platforms, ordnance stores, and service of the gun, may be made available. The improved rifle projectiles for them, to be used for the principal service for which they will be hereafter required, will, by their use, give all the advantages enumerated; while to test the value of the improvement requires but an insignificant expenditure compared with the usual cost of experiments on ordnance.

The following axioms, founded upon the late discoveries in thermodynamics, and relating to the correlation and conservation of force, furnish reliable data from which we may determine to the value of many devices connected with ordnance and the cause of failure of many guns:

Whenever a gun bursts, or is injured by no greater charge than such as it has previously withstood without permanent change of form, it is because of the misdirection of part of, or all the force of, the powder, intended to be exerted on the shot to give it its projectile force, the condition required for range and penetration, to obtain which we make guns, or because part of the force of the powder has been expended in unnecessary friction, from the rubbing of the shot against the bore.

If the gun or shot, either or both, be heated to any degree while the projectile is being ejected, the force given to the shot would be less than it would be if neither had been raised in temperature.

If the shot or gun, either or both, be permanently changed in form while the shot is being ejected, the projectile force will be reduced in a ratio which may be exactly estimated.

If the shot be only changed in any of its dimensions while being ejected from the gun, *within its permanent elasticity*, so that it recovers its form after it has escaped from the muzzle of the gun, and if the change of form does not increase the friction while it is being ejected, no loss of power will result.

Any change of form of the gun, not recovered before the shot escapes, detracts from the projectile force imparted to the shot.

If an elongated projectile could be inserted in the gun of so much larger diameter than the bore that all the expansive force of the powder would be expended in forcing it out of the gun, and so that, no projectile force remaining in it, it would fall to the ground from the muzzle, all the work the powder had ability to perform would be found in the metal of the gun, and in the shot, in the other form of heat; and that part of the heat absorbed by the gun being communicated to a higher degree in one part of the metal than to other parts, the tendency to burst the gun by *unequal expansion* would result, the force of which may be estimated, heat and work being convertible conditions.*

If a lead bullet, laid upon an anvil, receives a blow from a hammer, no rebound of the hammer will occur; all the work of the blow will be found to have been expended in changing its form and increasing the temperature of the lead. But if the bullet experimented upon be of tempered steel, with sufficient permanent elasticity to cause the hammer to rebound, without permanent change of form, no increase of temperature will be found to have resulted in the bullet, because no work will have been expended upon it; from which data we may conclude that, if projectiles of all the various forms used in great guns could be caused to slide smoothly out of the gun, invariably without friction, the prolific cause of accidents to the guns would be avoided and the misdirected force would be stored up in the projectile instead, to be expended in the desired manner.

A few additional familiar examples of the correlation of work and heat, as applicable to gunnery, may be recited.

Aerolites, projected through the earth's atmosphere, are supposed to have their high temperature—the welding heat of wrought iron—imparted to them by friction against the air.

A lead bullet, fired from a rifle into the muzzle of a horse-pistol, has been known to melt and run out of the muzzle in liquid form.

Lead bullets fired against iron targets in the dark have been known to emit a flash of light, on account of their sudden increase of temperature upon striking.

Railway-axes frequently become red-hot by friction, and set fire to combustibles near them.

Wrought-iron projectiles have become jammed in wrought-iron guns, and thereby heat enough has been evolved to weld the two metals together.

A common example of welding of metals by the heat of friction is known to millers. The step, or hardened steel point, at the bottom of the mill-spindle, upon which the

* General Rodman, in giving testimony before the Joint Committee on Ordnance in relation to the cause of the bursting of a 12-inch rifled Rodman gun at Fortress Monroe, said: "The only thing that would indicate the bursting at that round is the indication of the shot having jammed in the bore of the gun, as shown by the impressions of the lands of the gun upon the surface of the shot. A great amount of friction would be the result; whatever friction existed tended to diminish the velocity of the shot."

weight of the millstone rests, is frequently found welded to the socket in which it revolves.

A unit of heat, being that amount of fire effort or quantity of heat necessary to raise the temperature of a pound of water one degree Fahrenheit, has a mechanical equivalent of "work" which is 772 "foot-pounds," or the ability to raise 772 pounds one foot high.

Seven hundred and seventy-two foot-pounds expended in friction, or in any other manner, evolve "a unit of heat."

A solid shot of 484 pounds weight, fired from the 15-inch gun with fifty pounds of powder, with a velocity of 1,028 feet per second, it has been found, stored up in the projectile work equivalent to 7,094,000 foot-pounds, or a momentum equal to raising that number of pounds one foot high. Twelve times that number of pounds *one inch high* equal 85,128,000 "inch-pounds," equal also to 9,189 units of heat. If one-tenth of this amount of work should be expended in friction on the bore of the gun, it being heated so suddenly from one surface of the mass, would be heated unequally, and unequally expanded, force enough would be developed to burst it.

A bar of wrought iron one inch square has its length increased one five-thousandth part by a tension of two thousand pounds; an equal extension of length occurs when its temperature is raised eight degrees Fahrenheit. When such a bar is heated eight degrees, it expands longitudinally with a force of 2,000 pounds.

If two bars of iron, of one inch area of cross-section each, could be firmly fastened together at the ends, so that one could not expand or contract without the other, upon raising the temperature of one eight degrees higher than its previous temperature, it would exert a force of *instant pressure* upon the other bar of 2,000 pounds.

If such bars should be formed into rings, like tire and felloes of a wagon-wheel, of such relative diameters that one would fit exactly inside the other, upon heating the inner one a tension equal to 2,000 pounds would be exerted upon the outside ring, if the increase of temperature should be equal to eight degrees. If the outside ring had been of such diameter as to necessitate its being heated before it could be adjusted upon the inner one, and the contraction caused a tension having a tendency to compress the inside ring with a force of 2,000 pounds upon it, the pair would be in a similar condition of *initial tension* with the Rodman gun, which is cooled from the interior more rapidly than from the exterior at the time it is cast, that condition being necessary to enabling a hollow cylinder to be afterward subjected to expansive force from within, to withstand it in the best manner. If too much tension be imparted to the metal of a gun in this manner, it may burst without any other force acting upon it, several of the Rodman guns of large caliber having burst in the foundry before their completion as guns.*

The ordnance engineer should not permit an ounce of momentum to be wasted, misdirected, or diverted from the objective point of all projectiles fired from guns in grim war, viz, getting through the enemy's defenses. One effective shot, getting through and expended on a vital part, such as a boiler, a magazine, the engine, or steering-gear, might be worth thousands that would miss, or only knock at the entrance. There has been too much reason to suspect that our ordnance authorities have adhered to their theory of "heavy projectiles, with low velocity," giving "racking effect," instead of relying on penetration, resulting from high velocity, from a tender consideration for

* The joint committee, in reference to this part of the subject in their report, says: "If the force with which metals contract when cooled is shown to be so potent as to break the gun from the inside when cooled from the outside, and from the outside when cooled from the inside, it can be seen that, if a gun be in a state of tension which has a tendency to compress the metal of the interior and extend the exterior, the heat afterward communicated to the surface of the bore by the burning powder, or by friction of the moving charge, would assist the pressure of the powder to burst the gun, especially if the gun should be fired a number of rounds in quick succession. This additional force being considered, it may be possible to determine why guns made of the strongest material are more liable to burst than those made of weaker iron, and why the accidents occur most frequently during battle, when the gun is fired more rapidly than at the time of proof, when it is usually fired slowly. Forces known to be sufficient to actually break large masses of iron spontaneously, as it were, should not be overlooked while treating so intricate a subject as this of heavy guns."

While it must be conceded that the conclusions of the committee, that a gun which embodied the least strain of initial tension, to enable it to best resist the direct pressure of the gases of the powder, would be in a worse state to resist the force of unequal expansion, are correct, it must be remembered that, even when the gun was made on the plan of Admiral Dahlgren, it was able to, and did invariably, resist the direct pressure of the gases of the powder, *when no heavier projectiles than the solid round shot was used*; and, if made on the Rodman system, while it was plainly strong enough to resist the pressure of the powder, even with elongated projectiles, *it only gave way when a large additional force, resulting from friction, which expended at least one-quarter of its velocity, was acting upon it*; and most of the Rodman rifle-guns which have burst did give way while they were comparatively new. In this view of the subject, the chapter on "The effect of time in removing tensions," &c., (see the report of the Ordnance Committee, p. 189,) is significant. It is, therefore, fair to conclude that, if we can so direct the force that no part of it shall be expended upon the gun, except the direct pressure of the powder, we may find our present guns, whether cast hollow or solid, may be used for rifle-projectiles of the same weight as the solid round shot, of the same caliber, for an unlimited number of rounds, without the least danger of bursting, because the force heretofore occasionally devoted to burst the gun will, if the plan proposed succeeds, always directed aright, give increased velocity to the projectile.

the guns, despairing of success in attempting to secure greater efficiency from the guns we have or obtaining better ones. If a large part of the work the powder is capable of performing in the gun has been misdirected, as shown, and has thereby had a tendency to burst the gun, instead of giving high velocity and penetrating power to the shot, then it would be most proper to endeavor to modify the engine, so that the same charge, directed aright, will give us the quality of penetration, in addition to better endurance to the gun. Afterward, if it is desired, the "racking effect" may be secured by reduced charges of powder, by which we shall retain all we have and win that which we have not: reliable endurance to the gun and high velocity to the projectile.

If we can cause it to be understood, by the publication of the results of practicable tests and experiments, that the large number of enormous guns we have on hand have been unexpectedly increased in efficiency, so that each has had imparted to it reliable endurance under rapid fire, with improved projectiles, stored with momentum which will send them easily through the thickest armor-plating carried on any foreign iron-clad, the fact that we have many foundries capable of producing unlimited numbers of similar or larger guns of the same quality, from American iron, at a cost of ten cents a pound—only one-quarter to one-tenth of the cost of the guns relied on in Europe—would make the award of Alabama claims one or two hundred millions greater, insure prompt payment, and also insure permanent peace in the future between the United States and European nations.

At this time, the "racking effect" we have boasted of is ridiculed in England as the best our guns can give, even if the guns do not burst, as they are liable to do, at the first round.

The improvement I propose for the present smooth-bore guns consists essentially in rifling each gun with two grooves, having, for a 15-inch gun, a twist of about one full turn in fifty feet, and so stationing the grooves at the side of the bore (see photographic sheet of drawings, No. 1, being a plan, a longitudinal section, and front view of a converted gun, showing the number and station of the grooves) that neither groove will intersect or cross the bottom or top of the bore, thus leaving it smooth at the bottom and top, where the shot would strike in "balloting," should the gun be used as a smooth-bore, for spherical projectiles, after being rifled. After the gun is rifled, however, it is proposed to improve the spherical projectiles now on hand by some plan similar to the following, viz: by drilling three small holes in each, a little distance from the point of contact the shot or shell would have with the bore of the gun, when inserted, as if for firing, the holes to be equi-distant from each other, in the form of a regular triangle. Into these holes insert three brass pins, each to be cut, after insertion, of such exact length as to support the projectile up and out of contact with the bottom of the bore, so that the windage shall be equal all around, top and bottom, as well as at the sides of the bore, the pins supporting the projectile in this position like the legs of a milking-stool.

The injurious effects which result from the upsetting of the projectile (see photographic sheet No. 2) has been referred to. The injurious effect shown would be magnified in a rifled gun with an elongated projectile. The spherical projectile lying upon the bottom of the bore, and in contact with the metal of the gun at that point, upon receiving the sudden impulse acting against its rear, has its form changed to that of an *oblate spheroid*; the axis, which coincides with the axis of the bore of the gun, is reduced in length, and the diameter at right angles to this axis is increased, within a period of time too short to be estimated. The time, in fact, is so short that the projectile prefers to indent the bottom of the bore, instead of being lifted up to the extent the increase of diameter requires; and while the shot is so penetrating the bottom of the gun, the pressure behind it causes it to slip along the bore, creating friction, as if the shot had thousands of tons weight loaded upon its top while it is moving. It quickly (for whatever is done upon this occasion is done quickly) recovers its form by its permanent elasticity, and, jumping up, it strikes the top of the bore a little forward of its first position, and flies, balloting, or rebounding, from top to bottom of the bore, until it escapes in an uncertain direction from the muzzle of the gun. By supporting the projectile centrally in the bore, previous to its receiving its impulse from the powder, with windage all around alike, an achievement is arrived at, by most simple means, often attempted in this country and in Europe, but without success. The so-called central system of Captain Scott, royal navy, only centered the shot in the gun, after it had moved from its first position, and after the force of the powder had acted to upset the projectile. That so distinguished an officer should have attempted to overcome the difficulty, however, showed that a difficulty existed and that a remedy ought to be found. (See Holley's Ordnance and Armor.)

Spherical projectiles cannot be fired from rifled guns, if rifled in the ordinary manner, as the balloting, before referred to, would soon destroy the bore, rendering it unfit for either kind of practice.

The most effective kind of firing from "shell-guns" is what is called "*richochet pratique*." In attacking water-batteries, or earth-works near the water's edge, and low down; to sink transports, tugs, and wooden ships with shells; to resist offensive opera-

tions of the enemy, conducted in boats, such as landing of troops, &c., round shells and the *ricochet* firing is necessary, and cannot be adopted with elongated projectiles, or those having the rifle-motion imparted to them. This is well known and understood by naval men, and is the principal objection urged by them against the use of rifled guns exclusively. The improvements upon smooth-bore guns, referred to herein, give increased efficiency to the guns to be used as smooth-bores, and at the same time renders them available as rifles. It is based upon the idea that cast-iron guns, whether made according to the system of Admiral Dahlgren—"cast solid, and cooled slowly from the exterior, to leave the whole metal of the block as nearly as possible in a state of *"initial rest"*—or whether made after the plan of General Rodman, under which the gun is cast hollow, and cooled from the interior most rapidly, for the purpose of obtaining the supposed advantage of *initial tension*, by which the ability of the gun to resist elastic pressure from within is believed to be greatly increased, either kind of gun is believed to be capable of restraining the direct pressure of the powder, if no other quality of the force the powder is capable of exerting should at any time be permitted to act upon them. If this idea be a correct one, and if it had been known from the first, all the thousands of guns made, experimented upon expensively, and disabled or burst since the United States began its efforts to produce guns of large caliber, the millions of pounds of powder, hundreds of thousands of projectiles, and the immense expenditure of money wasted might have been saved, or the bursted and disabled guns might have been on hand now, ready to be rifled and mounted on ships or fortifications for the national defense.

Even now it is proposed that Congress shall appropriate \$200,000 for the procurement of one 12-inch rifle-gun, to be tested probably in the erroneous manner all the previous experiments have been conducted. This proposition embraces another which is, of course, to discard all of the 6,000 large guns now mounted on our ships and fortifications, to resupply all the projectiles, carriages, implements, and ordnance stores adapted to the old guns and not to the new, and to re-arm our forts and ships with the new device. If the new gun should happen—as it has many times before to trial-guns—to endure the proof tenderly applied, only to exhibit its weakness at the time of the next war—far in the future it is hoped—when it comes to be subjected to the real test of battle, referred to by the ordnance committee, namely, "rapid and continuous firing, with intervals only sufficient for loading," (see Appendix A,) it will not prove to be a wise expenditure. (See report, before referred to, p. 145.)

Rifled guns afford greater precision than smooth-bores, however well the gun may be shotted; the revolving motion imparted to the projectile compensates for the inequalities of density and form of any particular projectile. There are other advantages which result from rifling, the principal of which is that a better form of front can be given to the projectile for penetration.[†]

The hemispherical form of front is as much inferior to the ogival point of a projectile as it would be in a yacht, whether the object to be obtained is the penetration of air, earth, or iron plates. It has been found by actual experiments that the ogival-pointed form excels in penetrating iron plating in the ratio of 82 to 66. (See photographic sheet of drawing, No. 3.) And this great addition to the efficiency is absolutely obtained without any additional strain upon the gun, as completely as an improved model to a steamship gives increased speed without additional strain upon the steam-engine which propels it. As the principal duty expected of large guns in modern warfare is the penetration of iron plating, if no other advantage could be obtained, this alone would justify the change by rifling, proposed for all the smooth-bores possessed by the United States.

The rifle-projectile I have devised and adapted to the guns improved by rifling is shown in one of its forms or modifications on the photographic sheets, Nos. 4 and 5,

* (See second paragraph of foot-note to page 148.)

† From this table it appears—

"1st. That hemispherical-headed steel shot, striking the box-target with a 'work' of 66 tons per inch of shot's circumference, failed to penetrate completely. This result might be expected, as from calculation it would require about 82 tons per inch of circumference to send a hemispherical-headed shot completely through such a structure.

"2d. The ogival-headed steel shot, the head being brought to a point, striking the above target with a 'work' of 66 tons per inch of shot's circumference, penetrated completely, with some remaining force left.

"3d. That pointed chilled shot, striking the above target with a 'work' of 66 tons per inch of shot's circumference, penetrated completely, and were fully equal to the steel.

"4th. That elliptical, or blunt-headed, chilled shot, striking the above target with a 'work' of 66 tons per inch of shot's circumference, failed to penetrate completely, the indent being about equal to the hemispherical-headed steel shot.

"5th. That ogival-pointed chilled shot, striking the 4-5 inch unbacked plates, inclined at an angle of 38° with the ground, with a 'work' of 66 tons per inch of shot's circumference, penetrated completely.

"6th. That the same shot with the Belgian-coned head failed to penetrate.

"7th. That it would require a 'work' of above 70 tons per inch of shot's circumference to send a hemispherical-headed steel shot at an angle of 38° with the ground. Such a structure, therefore, presents a greater obstacle to complete perforation than the 'Warrior' target, if fired at direct."—Report of Captain W. H. Noble, M. A., Royal Artillery, associate member of the Ordnance Select Committee.

being cored shot of the same weight as the round shot for the same caliber gun. The above, plate 4, illustrates a coned shot of the same weight as the spherical projectile for same caliber of gun intended to be used, in comparative trials, to determine the relative initial velocity, precision, range, penetration of iron plating, and endurance. It has adjusted to it bronze "gibs," fitted mechanically to the grooves stationed forward of the center of gravity and of form of the projectile, the rear end of the shot being centered in the bore by 6 brass *boutons*, turned in a lathe after inspection, to fit as closely as will admit a ready loading. The *boutons* keep the periphery of the shot equidistant from the bore, all around alike. By this device all contact of the iron of the projectile with the metal of the gun is prevented and all the friction which would otherwise result is avoided. The shells in plate 6 are designed for converted smooth-bore guns, and adapted to the weight of the gun.

It is obvious that the spherical projectiles could be mounted in the same manner on the "gibs" in the rifle-gun, if it should be deemed desirable, and thus the advantage of the rifle motion to round projectiles could be secured; although the gib, being stationed on the part of the shot where the diameter is largest, would, therefore, have the pressure of the powder acting against the end of the gibs as severely as it acts against the rear of the shot, it is believed that it would not upset it, injuriously, so as to create undue friction in the grooves. The other shot has the gibs stationed forward of the largest diameter, where the windage is much greater, and no such injurious result could possibly be expected.

These improved rifle projectiles being all of the class termed "mechanical-fit" shots, a term used in contradistinction to expanding projectiles, or those having a soft metal, or expanding band, no "work" is expended in changing their form in the gun, a more important consideration than it would appear to be to the inexpert, and shown by the example of the lead bullet receiving the blow of a hammer, before referred to.

The photographic sheet No. 7 is intended to illustrate the important fact that three shots of greatly differing weight, (by length,) adapted to the same gun, may have impulse imparted to them with like charges of power, giving totally different rates of velocity, and yet have stored up in each an equal penetrating power as estimated by "foot-pounds," if it were not for the fact that more work would be performed on the projectile of the elongated form upon striking than upon the spherical one. This difference, however, could be compensated for by making the spherical shot of cast iron, the next larger of soft steel, and the heaviest one of tempered steel or chilled cast iron. The alteration of shape in Plate 8 involves work expended on the shot, and therefore wasted. The upset-shot makes a larger hole in the iron plate which it is to penetrate and necessitates that more "ability to work" should be stored up in the projectile.

It can be seen that all the improved rifled projectiles, cored shot, shell, steel-pointed shot, and chilled-iron shot, shown on the drawings herewith, have the least possible length commensurate with filling the bore of the gun except windage, and providing for the ogival-shaped point; and it is expected that the ability for work stored up in the projectile, being made up with more of the element of velocity than of weight, less of the work will be expended upon impact on the projectile itself, by heating it, changing its form, or breaking it.

A tallow-candle thrown against the panel of a door, with a proper velocity, might be so changed in form as merely to bespatter the target, without indenting it in the least, while it might be fired from a gun with such velocity as not only to penetrate the wood through and through, but to pass through without the slightest change of form to the unctuous projectile.

This example is referred to for the purpose of showing that, while in England ordnance engineers have been steadily attempting to impart "foot-tons" of ability to work and penetrate iron-plating to expensive, elongated, tempered-steel projectiles, we may, by imparting higher velocity to lighter projectiles, made of cheaper materials, (cast iron,) obtain the same penetration or better, and thus have both guns and projectiles at a cost of only from one-quarter to one-tenth the cost expended upon such engines in England and other European countries, where both guns and projectiles are made principally of steel, and in the most expensive and laborious manner.

I think that I may assert with truth that, since these improvements were invented, the drawings from which the photographic copies herewith were made have been shown to hundreds of engineers and practical mechanics, with full explanations in relation to all the details as shown in this paper. In every case I have asked their opinions and have been answered as follows:

"Question. If two guns of like weight, caliber, and quality should be mounted on like carriages, side by side, one to be rifled according to this plan and the other to remain smooth-bore, and if each should be loaded with the same charge by weight of the same kind of powder, the smooth-bore to have its proper round projectile, and the rifled gun to have the improved rifle-projectile of the same weight, and then each should be fired at the same elevation, which gun would give the highest initial velocity?"

"Answer. Undoubtedly the rifled gun would give the highest velocity.

- "Q. Which would give the longest range?
 "A. Undoubtedly the rifled gun, because, with its higher velocity its projectile has the best form for passing through the air.
 "Q. Which would give the best precision?
 "A. Undoubtedly the rifled gun.
 "Q. Which would penetrate the greatest thickness of iron-plating?
 "A. Undoubtedly the rifle, because it would have the highest velocity and because it has the best form of point for penetration.
 "Q. Which would injure the gun most?
 "A. Undoubtedly the round projectile; therefore the rifle-gun would have the most endurance.
 "Q. Which would give the highest velocity to a round shot, if both were loaded with such projectiles, the smooth-bore gun having its shot lying on the bottom of the bore and the rifle-gun having its shot supported centrally upon the brass pins?
 "A. Undoubtedly the rifle-gun."

I have no doubt, Mr. Secretary, that any committee of unprejudiced experts, before whom this subject is properly presented, would answer each of these questions substantially in the same manner.

I have two smooth-bore guns of 15-inch caliber, of superior quality, cast hollow, and cooled from the interior, directly under the supervision of General Rodman. The guns are new, and were made by the South Boston Foundry. I will rifle one of these guns, furnish new wrought-iron carriages for them, two wrought-iron plates for targets, 4½ inches thick, 36 inches wide, and 144 inches long each, all the necessary projectiles, both for the smooth-bore and the rifle gun, and all the implements required for a comparative test of the efficiency and endurance of the two guns, having in view besides the determination of the question as to which gives—

- 1st. Highest initial velocity to the shot of equal weight with equal charge of powder.
- 2d. Longest range.
- 3d. Best precision aimed at the bull's-eye of a target.
- 4th. Which will penetrate a 4½-inch plate with the smallest charge of powder. And,
- 5th. Which will have the greatest endurance, fired with such charges as will give the highest velocity to the shot from the smooth-bore gun.

I will furnish all the ordnance stores above enumerated and all the powder necessary for all the trials enumerated, together with the guns described, and conduct the test under the patronage of the Navy Department and the observation of such naval officers as you may direct to attend and record the results, for the sum of \$40,000, to be paid to me in advance, upon my giving security satisfactory to you for the faithful fulfillment of the conditions of a contract which shall embrace and express all these terms and conditions.

I have the honor to subscribe myself your obedient servant,

NORMAN WIARD.

HON. GEO. M. ROBESON,
Secretary of the Navy, Washington, D. C.

FORTY-SECOND CONGRESS, SECOND SESSION.

Letter from the Secretary of the Navy.

APRIL 10, 1872.—Referred to the Committee on Appropriations and ordered to be printed.

NAVY DEPARTMENT, *Washington, D. C., April 4, 1872.*

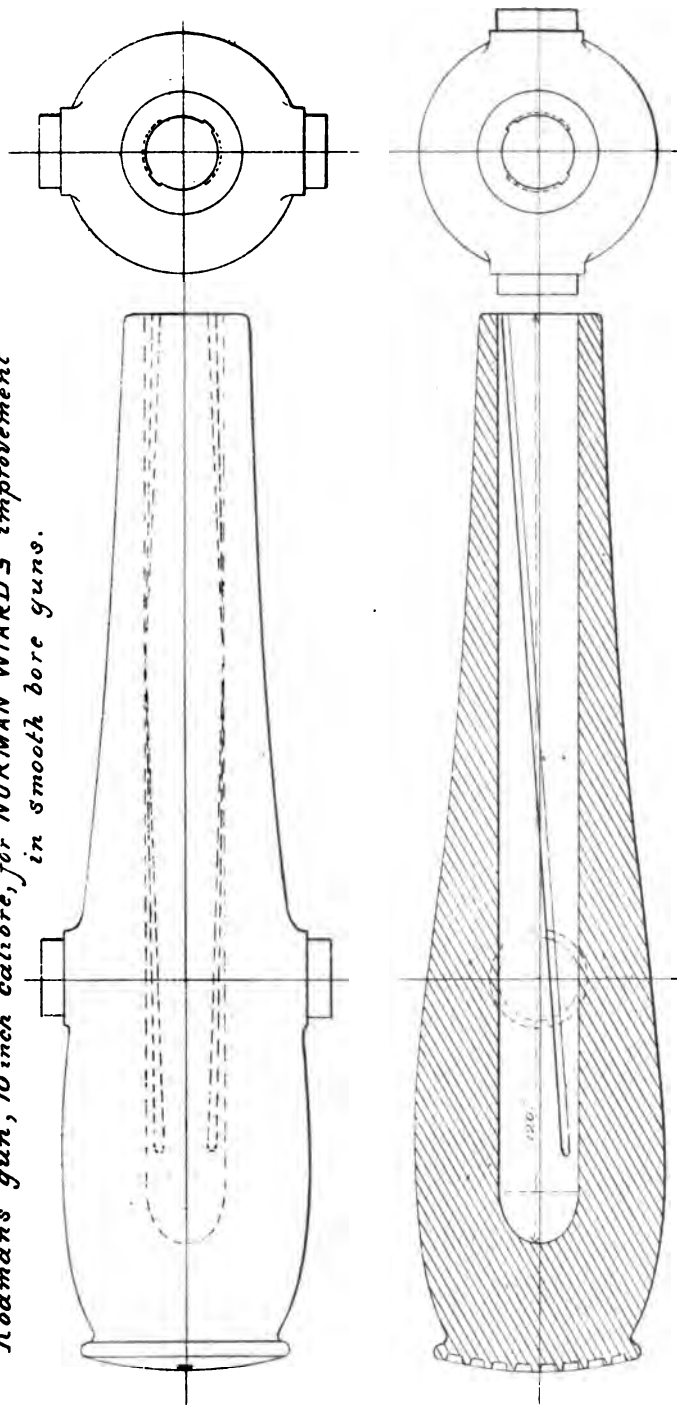
SIR: I have the honor to recommend that an amendment be inserted in the bill making appropriations for the naval service for the next fiscal year, appropriating \$40,000 to enable the Department to purchase two special, large, trial guns, and to conduct a series of experiments for the purpose of determining practically whether the present smooth-bore guns of the Navy can be increased in efficiency and strength by rifling and by the use of a new projectile, with a view of obtaining more reliable endurance, longer range, better precision, and a greater power of penetrating iron-plating.

A plan for this purpose has been laid before the Department which is claimed to possess such merit that it is deemed desirable to submit it to a full and complete comparative test.

The sum named is, by the terms of the proposal, to cover the entire cost of the two new 15-inch guns necessary—one of them to be rifled—together with all the projectiles, powder, iron plates for targets, carriages, and appliances required for the entire test.

The proposed expenditure is much below the usual cost attending similar experi-

PLATE 1.
*Rodman's gun, 10 inch calibre, for NORMAN WIARD'S improvement
 in smooth bore guns.*



Detailed dimensions omitted.

PLATE 2.

An upset shot, 10 inch calibre, smooth bore gun, exhibiting the cause of indentation, injury to the gun, and retardation of the projectile.

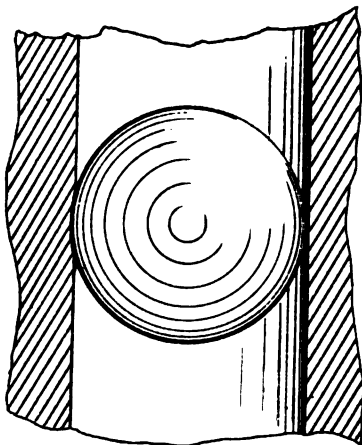
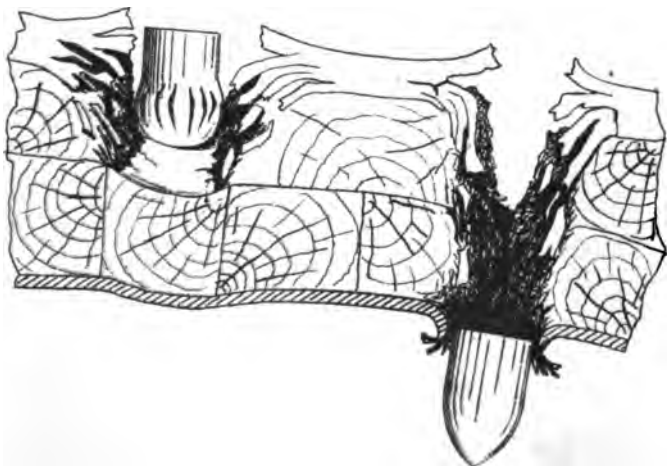


PLATE 3.



Section illustrating the difference in effect between a Round headed and Pointed headed shot.

From Capt. NOBLE'S Report.

PLATE 4.

Fig. 1.

*Cored shot 10 inch Calibre for NORMAN WIARD'S
improvement in smooth bore guns.*

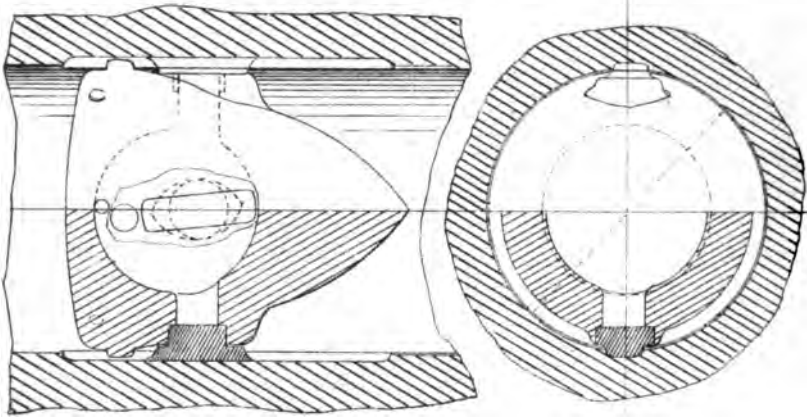
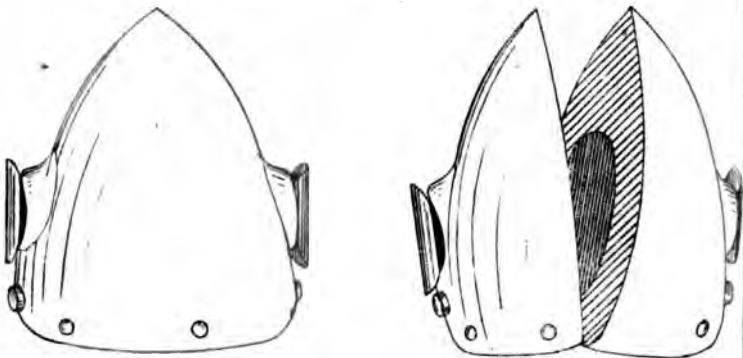


Fig. 2.

*Cored shot 10 inch Calibre for NORMAN WIARD'S
improvement in smooth bore guns.*



Detailed dimension omitted.

PLATE 5.

*Combined percussion and time fuze shell, 10 inch
calibre, for NORMAN WIARD'S improvement in
smooth bore guns.*

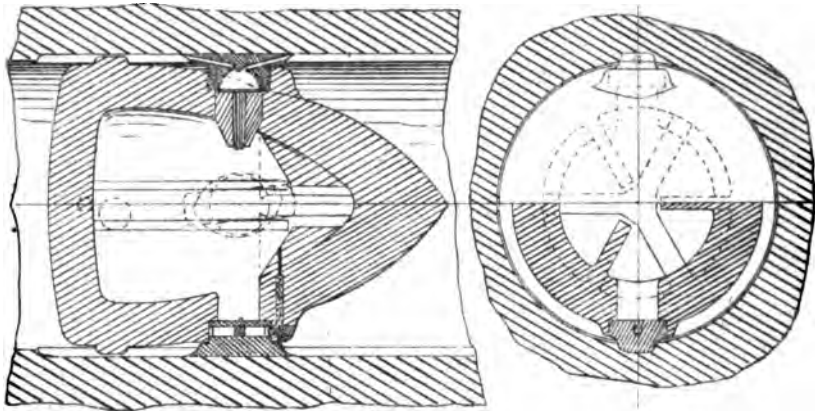
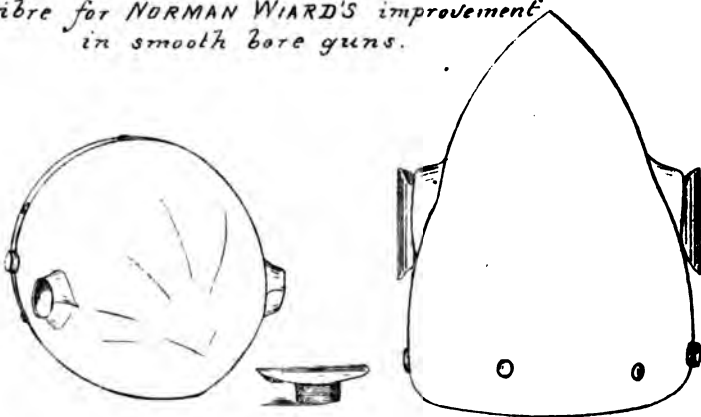


PLATE 6.

*Combined percussion and time fuze shell, 10 inch
calibre for NORMAN WIARD'S improvement
in smooth bore guns.*



Detailed dimensions omitted

From Capt. NOBLE'S Report.

PLATE 7.

*Steel Projectiles of 6.22 inch Diameter.
fired from 6.3 inch Gun at 4.5 inch iron plates.*



Weight 35.56 lbs.
Velocity 1496.5 feet
Work on impact } 552 foot tons



Weight 71.00 lbs.
Velocity 1059 feet
Work on impact } 552 foot tons



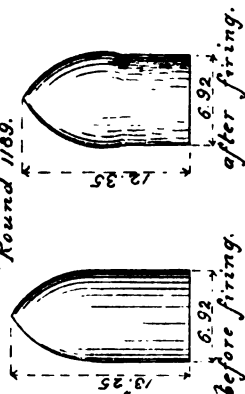
Weight 106.62 lbs.
Velocity 864.2 feet
Work on impact } 552 foot tons

From Capt. NOBLE'S Report.

PLATE 8.

*Showing the Alteration in shape caused
by the firing of Solid Steel Shot at iron
defences. Table IX.*

*Ogival or pointed headed
Round 1189.*



*Hemispherical headed.
Round 1201.*

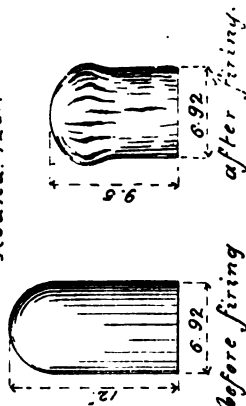
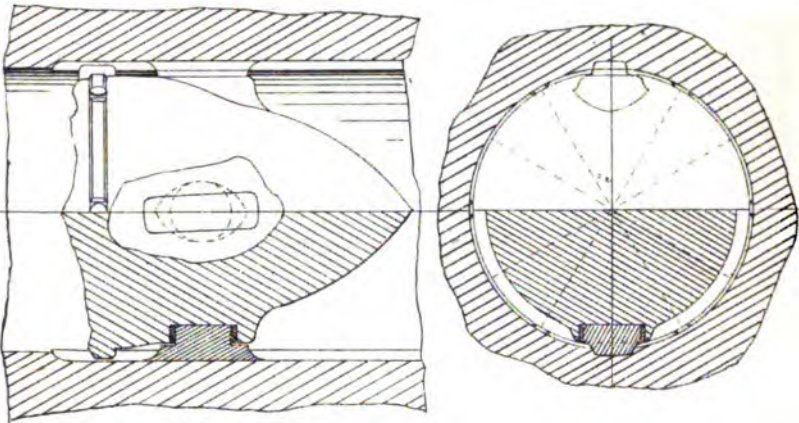
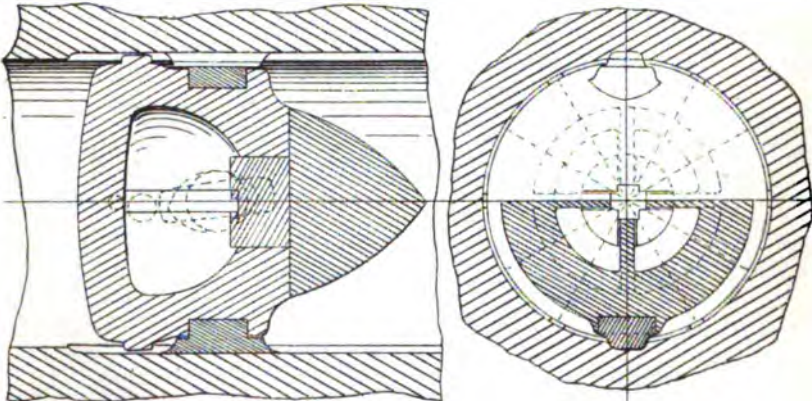


PLATE 9.

*Chilled iron ogival pointed shot, 10 inch calibre,
for NORMAN WIARD'S improvement in smooth bore guns.*

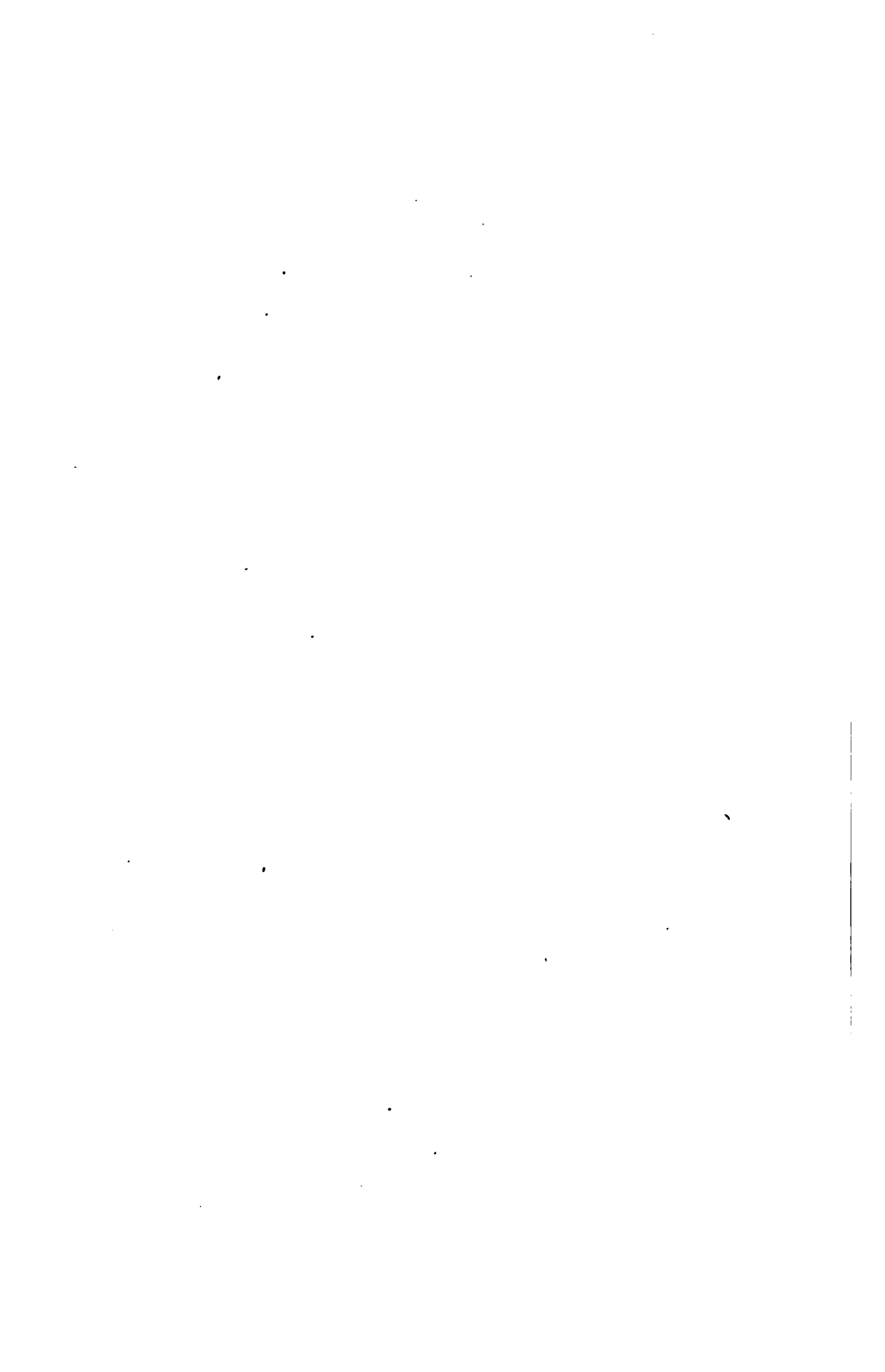


Cast without a "sinking head."



*Sub-calibre ogival steel pointed shell, 10 inch Calibre
for NORMAN WIARD'S improvement in smooth bore guns.*

Detailed dimensions omitted.



ments, and may result in enabling us to improve and utilize such of our present stock of guns as we may wish, at a trifling outlay per gun.

The importance of obtaining for the Navy large rifled guns of great power and certain endurance is believed to fully warrant the Department in asking for the appropriation herein recommended.

I am, sir, very respectfully, your obedient servant,

GEO. M. ROBESON,
Secretary of the Navy.

HON. JAMES A. GARFIELD,
Chairman of the Committee on Appropriations, House of Representatives.

Letter of Admiral Porter.

OFFICE OF THE ADMIRAL, Washington, D. C., April 5, 1872.

SIR: The attention of officers in the Navy is at present drawn to the plan of Mr. Norman Wiard for converting our heavy smooth-bores into rifled guns, at an expense so moderate, for each gun, that the Navy can be placed in a much more efficient position than it has been for a long time past, and with a future prospect of at least being able to compete with the navies of some of the smaller powers.

Mr. Wiard tells me that he is in hopes that an appropriation of \$40,000 will be made to carry on experiments with his 15-inch guns, and I sincerely trust that Congress will grant the means necessary to carry out these most important experiments, which, if they succeed, as I am quite sanguine will be the case, will save millions to the country hereafter. Should the plan prove successful, we shall have what no other nation possesses, a combined rifle and smooth-bore gun.

Should the guns fail in the experiment, we should still derive important information from the trial, and shall not have expended one-tenth of the amount annually appropriated by the English and French governments in trials of ordnance.

Hoping that you will give your hearty support to this important matter, I remain, very respectfully, yours,

DAVID D. PORTER,
Admiral.

HON. JAMES A. GARFIELD,
*Chairman Committee on Appropriations,
United States House of Representatives.*

[GENERAL NATURE—No. 79.]

AN ACT making appropriations for the naval service for the year ending June thirty, eighteen hundred and seventy-three, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and they are hereby, appropriated, to be paid out of any money in the Treasury not otherwise appropriated, for the naval service of the Government for the year ending June thirtieth, eighteen hundred and seventy-three, and for other purposes.

To enable the Secretary of the Navy to carry on his experiments toward converting heavy smooth-bore guns into rifled guns, with a view to obtain a combination gun possessing the qualities of both smooth-bore and rifle, forty thousand dollars.

Approved May 23, 1872.

APPENDIX A.

THE ORDNANCE PROBLEM IN ENGLAND.

[From the Naval and Military Gazette, May 11, 1872.]

It is not known what direction Mr. Gregory's motion as to cast-iron guns is to take, but if it arouses a discussion on the endurance of heavy ordnance much good may flow from it. Some persons assert that the war office is fully aware that the maximum amount of work is not got out of the material employed, († N. W.,) but that it is reluc-

tant to embark once more upon competitive trials. These add that tens of thousands are being yearly expended in a system of rifling which, as regards heavier guns, limits their endurance to slow firing, († N. W.) with intervals of weeks between every few rounds, and even then admits of only 100 († N. W.) discharges from 25-ton guns, with reduced charges of pebble-powder. The admiralty have had their attention called to the fact that the whole offensive powers of the Glatton are dependent upon the life of two of these guns; and as naval warfare demands continuous and quick firing, it is proposed to try whether one of the Glatton guns will endure a whole day's practice, firing 100 rounds at a target, with several degrees of elevation. This may set at rest an important point, which has never been settled, viz: Whether ships armed with 25-ton guns would not be disarmed by their own projectiles in the midst of an ordinary naval action.

Ibid., May 18.—The alarm felt on board the Bellerophon as to the disintegration of the 14½-ton guns while firing at targets in the Atlantic appears to have been a little exaggerated. It is quite true that the inner steel tubes have in three cases protruded († N. W.) themselves outside the muzzles; but this is probably due to the setting home of the outer coils. And it is also true that in two other guns the outer coil presents openings between them in a direction transverse to the bore, († N. W.) the separation in one case being one foot and in the other case 2½ feet from the muzzle. These separations occur just over where the accelerating spiral brings the greatest strain upon the rifling, († N. W.) But it is questionable whether either of the guns is really disabled. To the nautical eye, such cracks are not re-assuring. No doubt the guns would be better without them.

There is, as most officers are aware, "a cemetery of suicides" in the royal arsenal, to which heavy guns are consigned which have destroyed themselves under fire. Many additions have been made to this cemetery since the parliamentary returns of 1866, but we are without exact details as to the manner in which these more recent suicides destroyed themselves. The time seems, however, to have arrived when a further parliamentary return might be fairly given, showing what guns have been temporarily or permanently injured or disabled by firing since the introduction of the present system of rifling in 1865; the nature, position, and cause of the injuries; whether they necessitated any cessation of firing, and, if so, for how long; and whether the repairs were effected in the battery or ships, or after removal to the royal arsenal. To show that there is plenty of material for a somewhat lengthy return, we append a few examples which have come under our own notice, remarking that the list does not pretend to absolute correctness, and that it only refers to the home-station, and does not include the injuries, whether temporary or permanent, inflicted by the wabbling, hammering, wriggling projectiles in their efforts to escape from guns fired on foreign stations. The general testimony of naval men, that their projectiles almost invariably make an intermittent puffing noise in the air, and display a remarkable waltzing action in their flight, and not unfrequently break up in escaping from the gun, together with the incipient abrasions discovered in the Monarch's 25-ton guns after an average of only thirty-five rounds, warrants the assumption that the above list is a very small moiety of the injured guns which the admiralty could produce, if required to do so.

A few years ago a 9-inch gun burst violently on board the Russian frigate Alexandra Nwsgi, in the Baltic, killing twelve officers and men and wounding thirty persons, and seriously damaging the ship. This explosive burst was, at the time, attributed to the gun being made of block-steel; but the most cursory view of the "cemetery of suicides" at the royal arsenal will show that this is not the only material liable to such fearful explosions. Whenever a projectile jams in its exit from a gun, with a heavy charge behind, it matters not what material it is made of, an explosion must take place. Several wrought-iron coil guns, as well as converted guns and rifled cast-iron guns, have had studded shot wedged in their bore while firing with consequences only not like that of the Alexandra Nwsgi because the guns' crews were hid away behind traverses and other safe retreats. We have not included in our list those explosive bursts which occurred to guns rifled on the various abandoned Armstrong systems. But we may mention the jamming of a lead-coated shot in a breech-loading Armstrong-coil gun, 40-pounder, and the jamming of a studded projectile in a 9.22-inch Armstrong-coil Hurst gun, as instances of explosive burst under those systems. The fearful explosion of the converted 7-inch 68-pounder of ninety-five hundred-weight into seventy-six pieces, which were flung over an area of 580 yards by 150 yards, mentioned below, was similarly due to the wriggling projectile being unable to get out of the gun, and not to the material, faulty as we conceive it to be, of the converted gun. Such an explosion may always be expected whenever the pieces of a broken projectile wedge themselves in a heavy gun, whatever material it be made of. Even the improved Armstrong or Frazer-built gun cannot withstand such a wedge, as was seen in the case of an explosive burst of a 12½-ton gun in 1863, and in others now in the "cemetery of suicides," the particulars of which have not reached us.

Whenever a studded projectile breaks up in a gun through its stud-holes, it is a

mere accident that the broken pieces do not wedge themselves in the bore across the spirals, and the wonder is not that "the most magnificent guns in the world" are occasionally exploded by the wedging of broken or studded projectiles, but that they escape explosion so frequently, and are only disabled temporarily or permanently, or otherwise injured by projectiles which so frequently break up in the bore. * * * We may shut our eyes like the ostrich by burying our heads in the sands of secrecy, or enjoy the silence of the official fool's paradise, but nothing is more certain than that the present system of rifling frequently causes projectiles to break up in the guns; that such projectiles have jammed in our guns, and that those guns have exploded with fearful violence.—(*Ibid.*)

APPENDIX B.

THE ORDNANCE PROBLEM IN THE UNITED STATES.

Question. Will you give a brief history of the endurance of these guns?

Answer. The first 12-inch gun, the only one that has been proved to extremity, has been fired, I think, about 450 fires. * * * That gun burst, as was supposed, by the jamming and wedging of the projectile in the bore.

These guns have both been subjected to extraordinary pressures from the jamming and upsetting or breaking of the projectile inside of them.

Question. Do ordnance officers all agree that the breaking or bursting of the projectile is the chief cause?

Answer. No; not that it is the chief cause, for the reason that it ought not to occur, but that it is a potent cause when it does occur, especially the upsetting of the body of rifle-projectiles.

Question. * * * * * Why is there no certainty of the cause?

Answer. When a gun bursts, and you find the shot fired at that time to indicate jamming or wedging, or you see that it is broken, the presumption is, and I think as a rule a fair one, that that was the cause of the bursting of the gun at that round. * * * My belief is that, after we shall have procured a projectile that is as certain in its operation in the rifle-gun as the round shot is in the smooth-bore, we can, by firing to extremity one or two 12-inch guns, fix a limit within which the gun may be considered as absolutely safe, but it will require experiment to fix that limit.

It is more difficult to get a perfectly safe projectile for a large gun than for a small one.—(*Testimony of General Rodman before the Joint Committee on Ordnance.*)

It is, therefore, of the highest importance to obtain, if possible, some kind of heavy ordnance which shall not be liable to these objections. The entire efficiency of an iron-clad vessel, costing the Government hundreds of thousands of dollars, may depend almost entirely upon the character of the guns with which she is armed. In the words of the Assistant Secretary of the Navy, you might lose a battle by going into action with a gun around which stood 25 men entertaining the idea all the time that it might burst. Considering the great cost of our iron-clad vessels, and the importance of the results to be attained, by rendering them as secure and efficacious as possible, a few thousand dollars more of expense would seem to be of but little moment, if it affords the only means of reaching the end desired. The disastrous results attending the bursting of a gun can be, to a greater extent, guarded against upon land than at sea. In the latter case the loss of the vessel, with all on board, may be the consequence, while the demoralization of the crews of the other vessels similarly armed may lead to results almost, if not quite, as disastrous. But upon both land and sea, it is of the utmost importance to obtain heavy ordnance of the most reliable character.—(*Extract from the report of the Joint Committee on the Conduct of the War.*)

Each system of guns introduced in our service has been subjected in proof to tests supposed to demonstrate beyond question its ability to perform the work required of it, but each has failed when submitted to the real test of service. In the operations upon Morris Island 22 large guns was the greatest number mounted at one time, yet 50 in all burst during the siege, as is shown by the evidence of General Gillmore. In the attack on Fort Fisher all the Parrott guns in the fleet burst, according to the report of Admiral Porter. By the bursting of five of these guns at the first bombardment 45 persons were killed and wounded, while only 11 were killed or wounded by the projectiles from the enemy's guns during the attack. The battle at Fort Fisher was the only occasion during the war when rifled guns of large caliber were fired rapidly and continuously for a great number of rounds.

The failure to discover the weakness of these guns before putting them in the field, or on board ship for actual service, must be attributed to a defect in the system of proof employed. These systems appear to have been comparatively valueless and to

have proven little or nothing respecting the ability of the gun to perform the work expected of it in battle. The committee cannot learn that any method of proof has been practiced in the Army or Navy which subjects guns to the tests they must endure when first brought into actual combat, namely, rapid and continuous firing, with intervals only sufficient for loading. Excessive charges have been used and a great number of rounds fired, but no attempt has been made to copy upon the proving-ground the conditions existing in battle. In the new conditions developed by the rapid and long-continued firing in battle, not present during the slow and careful firing when in process of proof, it would seem must be found the cause of the frequent rupture of the guns. The most important new condition present during rapid fire would seem to be the communication of a greater amount of heat to the bore of the gun, having a tendency, by its expansive force, to aid the powder in effecting a rupture. If the gun be fired rapidly so as to allow little time for the bore to cool between each discharge, it is believed that the heat communicated would exert a powerful expanding force, while if there should be long intervals between the shots, even if the charges were excessive, sufficient heat to burst the gun might not be communicated to the interior. In reports of ordnance officers, the effect of unequal cooling in inaugurating unfavorable tensions in a gun cast solid and cooled wholly from the outside is treated at length, and it is shown that fissures and ruptures have resulted from the contraction toward the outside as the gun cooled, and it is stated that three-fifths of the strength of the gun is expended in this manner, leaving only two-fifths to restrain the pressure of the powder. The hollow mode of casting of the Rodman system and the band of wrought iron applied to the Parrott gun were intended to utilize this force of contraction, by assisting the strength of the iron to restrain the pressure of the powder. It was afterward noticed that several of the Rodman guns cast hollow, and cooled from the interior, burst in the foundry from the excess of this force of contraction exerted in the opposite direction from that before referred to.—(*Extract from the report of the Joint Committee on Ordnance.*)

THE STORY OF THE GUNS.—The English guns are made in the most expensive manner, of the best steel and wrought iron, costing ten times as much as our cast-iron ordnance. Yet the Naval and Military Gazette, referring to them in an article entitled "The suicidal system of rifling British guns," furnishes a list of thirty-three, having an aggregate weight of four hundred and fifteen tons, of various rifled calibers, ranging from seven to twelve inches, which had lately been injured or disabled on the home-station alone.

Thus it appears that our English cousins have found that there is a practical difficulty attending the making and use of large rifled guns; but they have only got half the idea as to what the difficulty is. The question is one of great consequence, involving millions, and it is gratifying to us to be convinced that to an American inventor, probably, the credit must be given for having discovered the errors of construction and operation attending the adoption and procurement and use of great rifles, together with a remedy for the low endurance, so simple that it is available for converting our present stock of smooth-bore, cheap cast-iron guns into the most effective rifle-guns possessed by any nation in the world, at trifling expense and without even dismounting them from their carriages. It is also gratifying to know that we have in our present cabinet a Secretary of the Navy sufficiently alive to the necessities of the service and sufficiently practical to comprehend, not only the intricacies of the compound engine, but the technicalities of a subject which has so puzzled the most experienced experts in the world as to be, by common consent, termed "the ordnance problem," and as to which the inability to see clearly through its solution is confessed, even by the most experienced.

The late Admiral Dahlgren, the late General Rodman, and many officers of our Engineer Corps, whose attention has been to a great extent directed to this subject for the past few years, have placed their opinions on record to the effect that we have not yet secured for the United States service a reliable system of rifle-guns, of caliber, endurance, and power sufficient for the penetration of iron-plating, such as forms the armor of modern ships of war. The English guns greatly exceed ours in power, but the above reference to their "cemetery of suicides" is a plain indication that they lack the requisite endurance, as well as that the endurance *they seem to have* is uncertain. If the amount of work a powerful large gun will perform could be foretold with certainty, even though it should be only the ability to endure one hundred rounds, it would be something; but experience has taught all nations that there is no number of rounds they can predict any gun will withstand, however strong its material or construction may be, and, as said by Admiral Dahlgren, "it is the unexpected bursting of guns which does the mischief."

It is believed that the upsetting of the projectile in the gun while it lies on the bottom of the bore, by which the shot is increased in diameter, so as to indent or actually penetrate the metal of the gun with such force that a large part of the work the powder is capable of performing is expended upon the gun—having a tendency to burst it—at the instant the pressure of the powder forces it to slide out of the gun, the

friction and abrasion which result detract from the power of the projectile, while it expends the diverted force to the object of bursting the gun. It being projectile force to the shot we want, instead of burst guns, this plan contemplates so mounting the shot within the bore that it is in effect suspended centrally, and escapes essentially without any contact of the iron of the shot with the metal of the gun, and with greatly increased force—the very condition sought for. Rifle projectiles are more upset in the gun than spherical ones of the same caliber; and hence it is that rifle-guns are more liable to burst than smooth-bores. However, round-shots for large calibers are also upset injuriously, and by removing the cause—indentation, abrasion, friction—the result, bursting, will not occur.

If these anticipations are realized the United States will be found, as if by magic, as well or better prepared for offense or defense than any nation with whom Alabama claims have to be settled, and hundreds or thousands of tons of old iron will be converted into the equivalent of twenty millions of gold.—(*National Republican*.)

[Inclosure.]

No. 2 a.]

48 BROAD STREET, NEW YORK, July 8, 1872.

GENTLEMEN: I propose to fabricate, from the best charcoal neutral cast iron, a 12-inch rifled gun, to weigh not less than 70,000 pounds; the gun is to be cast hollow and cooled from the interior; the metal necessary to secure the increased weight will be principally added behind the rear termination of the bore, but in addition to this, beginning with a muzzle of the same diameter as the "15-inch" gun, the diameter will be gradually increased from the muzzle along the chase, toward the breech, continuing along the re-enforce to the cascabel, retaining, with the above differences, as near as possible the same general outline of form as that adopted in the latest "15-inch" guns designed by General Rodman.

The gun will be rifled with two grooves, after the plan adopted for an experimental gun now nearly ready for the Navy, which is more fully described in the printed letter addressed to the Secretary of the Navy, referring to "combined rifle and smooth bore guns;" a copy of which I lay before you herewith.

The projectiles also will be essentially the same as those being provided for the Navy experiment above referred to, but will be increased in weight to about 600 pounds, by increasing their length while retaining the ogival point.

In designing and manufacturing this gun I hope to make a gun which may be reproduced cheaply and rapidly in large numbers in the future, if required; and if it should prove as successful as I anticipate, and which shall excel in power and uniform endurance all that was anticipated for the latest English 35-ton gun, even when fired as rapidly as possible with such charges of powder and weight of projectile as were contemplated by the designers of that gun, viz, 100 pounds of powder, with a 600-pound projectile, and that it will charge the projectile with more foot-tons of ability to work, each time it is fired, than has been achieved by that gun for any single round.

I desire to stipulate that if this gun is ordered from me I shall be permitted to fire it not more than twenty rounds, after it is rifled, to test the correctness of the depth, width, and twist of the grooves, and the adjustment of the projectiles for it, before being required to turn it over for official inspection, test, and adoption as a trial gun by the War Department; and if any injury to the gun results from any of my private experiments, that I shall be permitted to supply a second or even a third, if I choose; and that I shall not be required to deliver any of the first guns I make to be submitted to test, if I give notice that I am willing to make and supply another in lieu of any of the first guns I make which, from imperfection or accident, I do not desire to offer as a trial gun. I, however, only desire to be paid for one. The price of the finally offered and accepted gun to be the sum of \$45,000, to be paid to me upon its delivery to the United States, and before it is subjected to the official test.

I also desire to stipulate that the extreme proof of 500 rounds each, with 100 pounds of No. 7 power, and a projectile of about 600 pounds weight shall be applied to the gun I make, and if the gun withstands the test without bursting, I offer to make twenty or more, but not less, of the same quality, material, weight, caliber, and model, for the price of \$10,000 each, and to provide as many projectiles as may be required, of the kinds used in the trial gun, for the price of 10 cents per pound.

Upon the supposition that trial projectiles may be used more than once, if repaired properly after each round, I propose to furnish as many projectiles as are necessary for the proof of the gun, if not more than one hundred, without charge.

Respectfully,

NORMAN WIARD.

The ORDNANCE BOARD ON HEAVY RIFLED ORDNANCE.

L. B., No. 5.]

ARMY BUILDING, NEW YORK, July 10, 1872.

SIR: I am directed by the board on heavy cannon to acknowledge the receipt of your letter (to Colonel Crispin) of the 8th instant, and the accompanying propositions and explanations, and to state that the board is ready to receive any communication you may be pleased to make, either verbally or in writing, further relating to your plans for the construction of heavy cannon.

Respectfully, your obedient servant,

C. E. DUTTON,
First Lieutenant Ordnance.

NORMAN WIARD, Esq.,
48 Broad Street, New York.

L. B., No. 15.]

ARMY BUILDING, NEW YORK, July 15, 1872.

SIR: I am directed by board on heavy cannon to inquire when you will be ready to present the additional plans, or views, or explanations suggested at your last interview with the board.

Very respectfully, sir, your obedient servant,

C. E. DUTTON,
First Lieutenant Ordnance, Recorder.

NORMAN WIARD, Esq.

L. B., No. 43.]

UNITED STATES ARMY BUILDING, NEW YORK,
July 26, 1872.

SIR: I am directed to inform you that the board on heavy cannon has adjourned to August 7, proximo, by which date it is expected that all matter intended for its action will be before it.

Your obedient servant,

C. E. DUTTON,
First Lieutenant Ordnance, Recorder.

NORMAN WIARD, Esq.

DR. W. E. WOODBRIDGE.

L. B., No. 3.]

ARMY BUILDING, NEW YORK, July 10, 1872.

SIR: I am directed by the board on heavy cannon to request that you will forward for its information such records as may be on file in the Ordnance Office relating to Dr. W. E. Woodbridge's method for the construction of cannon.

By direction of the board.

Very respectfully, your obedient servant,

C. E. DUTTON,
First Lieutenant Ordnance, Recorder.

The CHIEF OF ORDNANCE, U. S. A.,
Washington, D. C.

No. 38.]

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, July 13, 1872.

SIR: I send herewith, pursuant to your request of the 10th instant, papers from the files of this office relating to Dr. W. E. Woodbridge's method for the construction of cannon.

It is understood to be Dr. Woodbridge's desire that the descriptions of his method of construction be not made public.

By order of the Chief of Ordnance.

Respectfully, your obedient servant,

S. V. BENÉT,
Major of Ordnance.

The PRESIDENT OF THE BOARD ON HEAVY ORDNANCE,
Army Building, New York.

[Inclosure.]

WASHINGTON, July 30, 1850.

SIR: I would respectfully inform you that I have invented a new mode of making cannon, a brief description of which I herewith forward you, together with a statement of some of the advantages to be derived from its use.

I have also a model of the invention (a gun of $\frac{1}{2}$ pound caliber) which serves to show the mode of manufacture and the great strength of the material thus obtained, and which I shall be happy to exhibit at any time or place you may choose to name.

I am aware that the practical utility of inventions of this class can be fully determined only by experiments on a scale sufficiently large for actual service, and it is for this reason, together with the fact that I have not myself the means for trying the experiment upon such a scale, that I call your attention to the subject, with the request that an examination of the merits of my invention may be had, and if it shall appear likely to result in public advantage, that you would recommend an appropriation to be made to defray the expenses of such experiments.

It will give me much pleasure, if desired, to make personally any other explanation or statements of fact in relation to the subject, so far as I am able, whenever they may be called for.

I am, sir, with great respect, your obedient servant,

W. E. WOODBRIDGE.

Major-General WINFIELD SCOTT,
Acting Secretary of War.

[Indorsement.]

Referred to the Chief of Ordnance Department, who will report upon the merits of the improvement or invention.

WINFIELD SCOTT,
Acting Secretary of War.

AUGUST 5, 1850.

[Inclosure.]

(NOT TO BE PUBLISHED.)

The advantages of a new mode of making cannon, invented by William E. Woodbridge.

The advantages of a new mode of making cannon must be found either in economy or in an increased capability of the instrument. It would doubtless be advantageous to replace bronze guns, if used in ordinary naval service, with cast iron, on the score of economy; and it has been found advantageous in the field service to substitute bronze for cast iron, though costing perhaps four times as much, on the ground of increased capability.

How far my invention may be serviceable in either of these respects will best be seen after a description of it, and an estimate of the attending expenses.

The mode of making cannon which I propose is briefly this: I take a hollow cylinder of iron or steel, the internal diameter of which is somewhat less, and the external diameter of which is somewhat more than the intended caliber of the gun, and the length of which exceeds the intended length of the bore, and, having closed one end of the cylinder with a cylindric plug of iron which is allowed to project from the cylinder about three times its diameter, I wind upon the whole core thus formed iron or steel wire, drawn in such form as to have a rectangular transverse section, in close spiral layers, sufficient in number to give the required thickness, the direction of the spiral being reversed in each alternate layer.

The core and mass of wire wound upon it I then place perpendicularly in a suitable furnace, the closed end of the cylinder being down, and subject it to a heat equal to that of melted bronze, under circumstances which completely prevent its oxidation, and while it is thus heated cause it to be surrounded with melted bronze so as to fill, from the bottom, the spaces between the wires, thus soldering the whole together.

It is now allowed to cool, and is turned and bored to the required dimensions.

It is proposed to cast the trunnions on the gun in the process of soldering; but they may be forged in connection with a ring which may be threaded in the inside and screwed on the proper part of the gun threaded to receive it.

The former method is preferred.

It is believed that the great strength of the material prepared in the manner described is sufficiently apparent, and the model which I have made sufficiently demonstrates it.

It is inquired, however, will the solder interpenetrate a very large mass of wire wound as you propose? It would be satisfactory to answer the question by the experiment, which I cannot do at present. Without knowing precisely what cause is expected to interrupt the flow of the metal, it may be said that the condition of the mass of wire in the midst of the melted solder appears to be, in respect to interpenetration, analogous to that of a similar mass immersed in water, excepting that the surface attraction between bronze and iron appears to be much greater.

That the closeness of the winding will not interfere with the penetration of the solder may be inferred from the well-known fact that brass and copper used as solders will enter the closest joints and frequently penetrate between the fibers of apparently solid iron.

It is also to be considered that there will be no tendency to "blow" (as the expression is in regard to casting) when the melted metal is poured into a receptacle as hot as itself; for any substance from which vapor might arise will be already volatilized and the gases expanded so as not to be affected by the heat of the melted metal.

It has also been suggested as an objection to this plan that by the alterations of temperature to which a gun is subjected in repeated firing the metals of which the gun is composed may be separated in consequence of their different rates of expansion. This objection at first appears to be sustained by facts observed in relation to the union of different metals for various purposes in the arts; but it will be found in every case where separation is the result of alternation of temperature that the mass of both metals has borne a considerable proportion to the surface of union.

The principle involved in the consideration of this subject appears to be this: When the force and motion generated by a change of the temperature of the metal is sufficient to overcome the elasticity of either of the metals joined, it will, if sufficiently often repeated, result in the separation of the metals; but if the force or motion thus generated is insufficient to overcome the elasticity of either of the metals, the alternations of temperature may be repeated any number of times without effecting a disunion of the metals, and they will cohere with a force equal to the difference between the cohesive strength of the joining metal and the disjoining force.

It will appear from the application of this principle that the cohesion of the solder under the conditions in which we find it in our cannon (where it has a surface of union of at least 650 square inches to the pound) cannot be materially affected by any changes of temperature to which it is liable to be exposed.

It will further appear that, in consequence of the metals having been united at a higher temperature than that at which the cannon is used, its strength is *slightly* increased rather than diminished by an elevation of its ordinary temperature.

By uniting steel-wire in the manner proposed we obtain a material of about three times the strength of bronze and four times the strength of cast iron, and of sufficient hardness and elasticity, at a price which, it is believed, will readily admit of its use for the purpose designed, and which is believed to be particularly adapted to the fabrication of cannon, which, in order to be easily transported, are necessarily made light, and of cannon of very large caliber.

It is evident that field and mountain howitzers made of a material three times as strong as bronze, but in every other respect like those now in use, would in all cases be as serviceable, and where the recoil could be properly controlled would possess the additional capability of throwing solid shot with the charges now used for guns of the same caliber. Perhaps, also, with a material of the strength supposed, the length of howitzers might advantageously be increased, the weight remaining the same.

In making guns of increased caliber it becomes necessary to increase the thickness of the metal not merely in the same ratio, but in a ratio greatly increased, as appears from the following considerations:

The weight and consequently the inertia of a cannon ball is increased in proportion to the cube of its diameter, while the surface upon which the propelling power acts is increased in proportion to the square of its diameter; consequently the pressure per square inch must be increased in the ratio of the cube of the increased diameter to its square, or, which is the same thing, in the ratio of the increased diameter itself, in order that the propelling power may be in the same ratio to the inertia of the mass propelled, a condition necessary for its receiving the same velocity.

Accordingly, if we would make two guns capable of throwing balls suited to their calibers with the same velocity, but whose internal diameters should be to each other as four to one, we must give to the larger gun a strength sufficient to resist four times the pressure per square inch. Upon the supposition that, with a given diameter of bore, the strength of a cylinder is increased in the ratio of the increased thickness, (a rule which is proximately true when the thickness is small in proportion to the bore,) the required strength would be attained by giving the larger gun sixteen times the thickness of the smaller one.

But when the thickness of a hollow cylinder is proportionally great the rule becomes very erroneous, so much so that it is found that very little increase of strength is given to a cast-iron cannon by increasing its thickness beyond the diameter of its caliber.

The practical limit of proportional thickness of a hollow cylinder to its bore depends upon the tensile elasticity of the material of which it is made; and the limit of the absolute strength of which it is possible to give to a hollow cylinder depends upon the tensile elasticity and cohesive strength of the materials of which it is to be made.

The ratio of the absolute strengths which it is possible to give to hollow cylinders of different materials having the same elasticity is the ratio of their cohesive strengths.

Assuming the cohesive strength of brazed steel-wire to be four times that of cast iron, and its elasticity to be equal, and that cast iron is sufficiently strong for making guns of seven inches diameter, (42-pounders,) it will appear from the application of the rule above that the limit of the absolute strength which it is possible to give to a cannon of brazed steel-wire will not fall short of that required to give to a ball weighing 2,500 pounds, the velocity now given to a 42-pound ball.

The advantage of guns of large caliber for fortifications being already generally conceded, they need not here be mentioned.

WASHINGTON, August 5, 1861.

SIR: In consequence of the apparent necessity for guns of greater strength and endurance than are produced by any of the methods of manufacture now established, I am led to present anew the plan proposed by me at the Ordnance Office some years since, for making guns of steel-wire united by a non-fusible metal, asking such encouragement as you may see fit to give, by ordering a small number of guns for thorough trial, or otherwise.

The process is substantially as follows: The wire is wound in coils on a cylindric former, somewhat larger than the intended bore of the gun, a sufficient number of wires being wound at once, side by side, to produce the required obliquity of the turns, in successive layers of opposite twist, their number being of course sufficient to give the desired exterior diameter to the gun. When thus wound, the mass of wire is inclosed in a tight case to protect it from oxidation, and is heated therein to a temperature somewhat above that required for the fusion of the metal to be used for uniting it. When this is accomplished, the uniting metal is run in, filling the entire space within the case not occupied by the wire. When properly cooled, the gun is bored and finished from the mass in much the same way as if it were a common casting.

The bore of the gun will, of course, be made entirely in the poured metal, which may be a hard bronze, resisting well at the same time both abrasion and corrosion. The plan is applicable to large and small guns. The great strength and freedom from concealed and dangerous imperfections which may be thus obtained need not be dwelt upon.

The cost of manufacture by this method, after the first arrangements are made, it is believed need not at most exceed that of bronze, except in very light guns.

I will also call attention to a device for very readily bursting guns, a small model of which is left at the Ordnance Department, and which it will therefore be unnecessary to describe. It is designed to be useful in circumstances where the enemy's guns may be taken in possession, but cannot be rendered available by removal, or where it may be necessary to abandon a gun to the enemy.

I would be glad to enter into any arrangement by which these inventions may be rendered serviceable to the Government, and which my circumstances will permit.

Very respectfully, your obedient servant,

W. E. WOODBRIDGE.

General J. W. RIPLEY,
Chief of Ordnance Department.

NO. 84 NASSAU STREET, NEW YORK,
December 24, 1864.

SIR: As the attorney and agent of Doctor William E. Woodbridge, of Little Falls, New York, I respectfully call the attention of the Ordnance Department to his improvement in the method of constructing cannon relating to the use of steel and iron wire, united by soldering with bronze or other suitable material, which may be generally described as follows: The wire, which is square, is closely coiled in oblique layers of reversed spiral, over a core occupying the place of the bore of the gun, and thereafter heated to the melting-point of bronze, without exposure to oxidation, when that metal is supplied in a state of fusion so as to completely interpenetrate, surround, and unite the mass of wire.

Its claims for excellence are its extraordinary strength, lightness, and durability, and capacity to burn and employ a much greater quantity of powder than can be used

in any other gun we know of, in proportion to the weight of projectile, thereby obtaining a velocity, penetration, and range yet unattained.

A model gun was built after above design at Washington arsenal [navy yard] under auspices of Ordnance Bureau, during Admiral Dahlgren's administration as its head, which model is now with Mr. Stevens, of Stevens's battery, Hoboken, New Jersey. Its weight is 145 pounds, bore $2\frac{1}{4}$ inches, (not taking into account the groove;) largest diameter $5\frac{1}{8}$ inches. A piece was cut from the end of muzzle of this model gun, and its tensile strength ascertained to be 108,000 and some odd pounds to the square inch.

Captain (Admiral) Dahlgren was then at work on his own gun, and the interest of Dr. Woodbridge's gun was, perhaps, considered adverse. After much vexatious delay Dr. W., finding nothing further could be done, left Washington. The ostensible excuse was the lack of time and opportunity "in the midst of the important experiments being made" for trials of the plans.

This model gun has been fired a little more than a hundred times with very heavy charges considering the weight and caliber of the piece, (1 pound powder, 4 pounds shot,) and is a complete success. Doctor Woodbridge has been relying more upon the logic of events than anything else for bringing about the introduction of his gun, believing that his plan will eventually be adopted from the necessity of such guns in time becoming apparent.

The doctor is well and favorably known as a scientific man, and especially for his knowledge of ordnance, &c. As long ago as 1852 he published a pamphlet, (with several illustrations as to form of cannon, shell, and sabot,) regarding the giving of the rifled motion to cannon projectiles, and is to-day deserving of the gratitude and thanks of the nation, as also substantial reward from Congress, for his invaluable discoveries and services in rifled ordnance alone, now in use, disconnected from his name. Mr. Watson, Assistant Secretary of War, and Major Benton, I believe, entertain good opinion of this gun, and would favor its being tried on a larger scale.

In reply to my letter to the latter, in July last, as to having trial guns built, Major B wrote, "The proper course will be to submit a plan of Doctor Woodbridge's gun to the Chief of Ordnance, General Ramsey, and state for what price the doctor will furnish one or two of these guns to the Department. If the Chief of Ordnance desires my opinion in the matter he will probably call upon me first in an official form. I think he will do so, as I have paid some attention to the subject."

This course I have not hitherto pursued; the doctor's ill health, the demands of his business, and other circumstances, have prevented. He has written me, however, that detailed drawings can be completed and furnished if necessary at once, which, if desirable, I will forward, and can also submit proposals to build two trial guns, one of iron and one of steel wire, of say 8-inch, (200 pounder,) the size recommended by Doctor Woodbridge, the same to be built by Doctor W. at Little Falls, where he has the requisite facilities and resides.

Mr. Hewitt, (Cooper, Hewitt & Co.,) Trenton Iron-Works, offers to build two such trial guns, if requested so to do by the Ordnance Department, at the actual cost. Their attention has been directed to the subject, and they have faith in the efficiency of such guns. Their house is, I believe, well known to the Department, and somewhat similar business has been heretofore done by them for the Department, as I am informed. In case of such guns being built by Trenton Iron-Works, Doctor Woodbridge would give his personal attendance and superintend when necessary.

I inclose a statement prepared by Doctor Woodbridge, comparing Parrott and Dahlgren with proposed steel-wire guns.

I have the honor to be, sir, most respectfully, your obedient servant,

FRED. B. VAN VLECK.

Brigadier-General A. B. DYER,

Chief of Ordnance, Washington, D. C.

[Inclosure.]
Schedule comparing Dahlgren and Parrott with proposed steel-wire guns.

DAHLOREN.				PARROTT.				PROPOSED STEEL-WIRE.			
Designation of gun.	Charge.		Weight of gun.	Designation of gun.	Charge.		Weight of gun.	Designation of gun.	Charge.		Weight of gun.
	Projectile.	Powder.			Projectile.	Powder.			Projectile.	Powder.	
150-pounder*.....			15,000	300-pounder.....	350	25	28,000	30-inch riflet.....	2,000	300	160,000
80-pounder.....			8,000	200-pounder.....	150	16	16,500	30-inch smooth.....	1,000	250	70,000
30-pounder.....	38	3	3,000	100-pounder.....	Abt 100	10	9,700	15-inch rifle.....	1,000	250	70,000
	25	2		30-pounder.....	30-pdr. 3 to 3½	3 to 3½	3,550	15-inch smooth†.....	435	100	33,000
								10-inch rifle.....	300	75	21,000
								10-inch smooth.....	130	40	9,500
								8-inch rifle.....	200	50	14,000
								6½-inch rifle.....	100	25	7,000

* Abandoned, I believe.

† Greatest diameter of 20-inch rifle, 60 inches.

; Charge for Rodman's 15-inch gun: shell, 315 pounds; powder, 35 to 40 pounds.

FRED. B. VAN VLECK,
Attorney and Agent of Doctor Woodbridge, 83 and 84 Nassau street, New York.

[Inclosure.]

WASHINGTON, February 1, 1865.

SIR: I hand herewith a description of my mode of fabricating guns.

The cost of producing one 8-inch rifle would be, (at the present price of materials and labor,) as nearly as I can estimate it, \$22,000; and for a second gun of iron wire, \$12,000.

These are not prices which would be sure to cover the accidents occurring, even in the long-practiced art of founding, and consequently not such as I could safely agree to furnish them for.

Would my means warrant my assuming any necessary risk I would freely do so; as the Government is, however, by far the most largely interested party in the success of the undertaking, it would seem to be more properly the party to assume the cost of such trials as may be expedient. I propose, therefore, to produce the guns for trial at a cost to the Government of the actual outlay in their production, and doubt not that I can give proper reference and security in regard to the fidelity with which the means would be applied.

Projectiles for the tests could be furnished at 10 cents per pound at the present prices of metal.

The cost of guns of this kind, after establishing the manufacture, does not, of course, admit of as close determination now as when the proposed trial guns shall have been made.

I believe that one hundred guns, each of 6-inch, 8-inch, and 10-inch caliber, can be furnished for 80 cents per pound, of steel wire. The larger calibers would cost a little more than these, partly on account of the greater proportional expense of preparation on a smaller number. The use of a steel tube in forming the bore would cause a slight addition to the cost.

It would be a pleasure, sir, to confer personally, if desired, in relation to the subject, with yourself, or with any one to whom the matter may be referred.

Very respectfully, your obedient servant,

W. E. WOODBRIDGE.

General A. B. DYER,
Chief of Ordnance Department.

[Inclosure.]

W. E. WOODBRIDGE'S MODE OF FABRICATING WIRE GUNS.

The material which is considered best adapted for use, in the form of wire, in these guns, is steel of a lower degree of carbonization than tool-steel, an article which has, during the last few years, been brought into extensive use, and which appears to be produced with great uniformity of quality, both at home and abroad. The wire used in a small trial-gun was made by Messrs. Cooper, Hewitt & Co., Trenton Iron-Works, and was of excellent quality.

Iron wire would, however, serve to produce a gun of great tenacity at a less expense than steel. I have observed that iron wire acquires decided increased strength in passing through the treatment it receives in the gun-making process; and it would seem to me well worthy of comparative trial.

The form of the wire is square, with the corners slightly truncated. The metal to be used for uniting (or soldering) the wire, and which also constitutes the walls of the bore, is a bronze composed of five parts copper to one of tin. It is much harder than ordinary bronze gun-metal, of about the same tenacity, and though considerably less flexible, is sufficiently extensible for the purpose. Its fusing point is somewhat lower than that of gun-metal.

The first step toward forming the gun is the preparation of the core or barrel on which the wire is to be wound. The form of this core, and its position in relation to the finished gun, is shown in Fig. 1, the outline of the gun being represented by dotted lines. This core may be made entirely of bronze of the same composition that is used for uniting the wire. For guns of considerable size, however, it is doubtless best to make the part of smallest diameter (*a*) of steel, on account of its greatest strength, and also as furnishing the means of inserting a platina vent-piece in the desired position, as will be further explained.

The principal cylindrical portion of the core should be sufficiently larger than the intended bore of the gun to allow of finishing the bore, including the rifling, without cutting into the wire, (as the bronze is less easily corroded than steel,) and of sufficient length to allow the wire necessarily somewhat irregularly wound at the muzzle-end to be cut off in finishing the gun. The flanges, *b c*, may well be made of iron.

Rough drawings to illustrate
WILLIAM E. WOODBRIDGE'S
Mode of fabricating
WIRE GUNS.

Fig. 3.

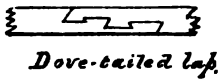
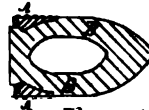


Fig 7



*Projectile.
 B. Iron part of projectile
 A Brass part,*

Fig 1



Fig 2

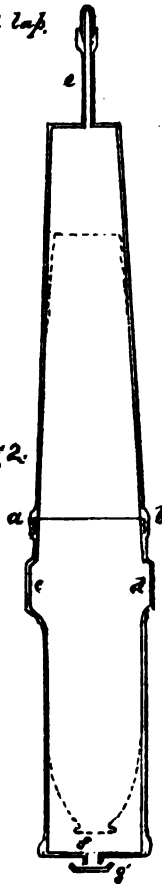
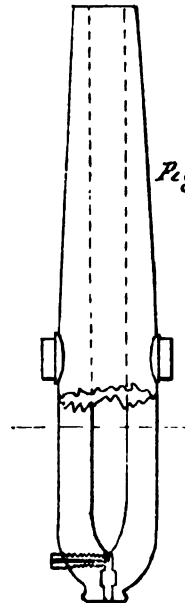


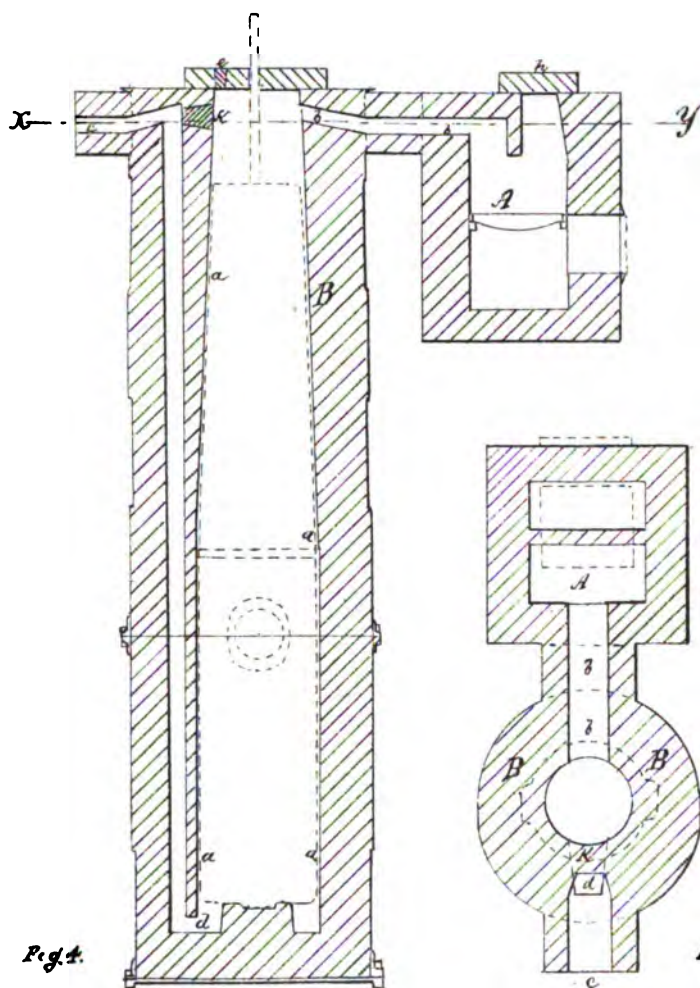
Fig 6



*Proposed model of
 8 in 200 pdr Rifle.*

Sketches of Core & Gun-case.

WOODBIDGE FURNACE.



*Furnace,
Perpendicular Section,*

Plan of Furnace, on X Y Fig. 1

In order to wind the wire upon the core, the latter is placed in a lathe or frame provided for the purpose, with means for rotating it with sufficient force to produce the tension necessary for close winding. In making an 8-inch rifle, about thirty-two wires, $\frac{1}{4}$ inch square, should be wound at a time. An equal number of holes, large enough to receive the wires, are to be made through the flange close to the body of the core, and at about equal distances from each other. Into these the wires are inserted and fastened, and brought together into a band of about eight inches in width. This band of wires, lying closely side by side, is passed between pinching-plates designed to produce nearly equal pressure on all the wires. The pinching-plates are mounted on the slide of the lathe, (or equivalent device,) so as to traverse, at the pleasure of the operator, a line parallel to the axis of the core. The rotation of the core draws the wires between the plates, which are advanced on their line of motion with such speed as is necessary to bring each turn of the band of wires in close contact with its predecessor. When the flange at the opposite end of the core has been reached, the obliquity of the wires is reversed, while under tension, and they are wound in a spiral of opposite direction. The process of winding is thus continued until completed, when the ends of the wires are fastened. It is not necessary that all the layers should extend over the whole length of the core, as the course of the winding may be reversed at any point.

As wires of sufficient length cannot be obtained in one piece, it becomes necessary to join them, which is done in the course of winding, though the ends of the wires may be prepared in advance.

Fig. 3 will sufficiently indicate a method of forming a dove-tailed lap which, with the aid of a simple machine, will, I think, form a very expeditious and good mode of joining.

Brazing is a method I have used, and which, with proper appliances, admits of tolerable expedition.

The wire, wound on the core, is inclosed in a case of iron before being subjected to the heat required for soldering, to protect it from oxidation. The case is represented at Fig. 2. It may be made of light boiler-iron, riveted and calked like an ordinary boiler. It is designed to part, for receiving the gun, on the line *a b*, where the upper and lower portions are screwed together, threaded rings being riveted to the plates for that purpose. Recesses (*c d*) are made in the case to receive the metal which is to constitute the trunnions of the gun. Extending from the top of the case, and opening from its interior, is an iron tube (*e*) of sufficient length to reach through the covering of the furnace when the preparations for heating are completed, and which forms a part of an arrangement for determining when the heat of the wound wire shall have attained the melting point of the bronze. For this purpose, two steel rods standing perpendicularly, one resting on bronze near the bottom of the core, and the other on the same metal at its top, are made to extend up through the iron tube and project a short distance above it. To the upper end of the iron tube is fitted one of glass, closed at the top. This permits the ends of the rods to be seen, without danger of access of air to the interior of the case. The falling of the rods indicates the fusion of the bronze on which they rested. Provision for the escape of air by expansion during the heating, and also during the pouring of the bronze, may be made in connection with this tube. The aperture by which it is intended that the liquid bronze shall reach the interior of the case and the wire inclosed, in the process of soldering, is situated at the bottom, and is shown at *f*, Fig. 2.

From it a short tube projects downward into a shallow iron cup *g*, attached to the bottom of the case, thus forming, when filled with melted bronze, an air-trap, admitting the flow of bronze through it, but excluding air from the heated iron. Before exposure to heat, the aperture *f* is tightly closed by a plug of bronze, which remains there until melted from its place.

Fig. 4 presents a section and Fig. 5 a plan of the furnace to be used in the operation. *A* is the fire-place, which need not be particularly described. *B* is the gun-chamber, the position of the case inclosing the wire being shown by the dotted lines *a a*. Heat from the fire enters the gun-chamber at the top by the flue *b*, and is drawn downward about the case and its contents to the outlet-flue *d*, which turns upward and enters the chimney at *e*, nearly on a level with the top of the chamber. Both it and the flues are inclosed in a casing of boiler-iron, strong enough to resist the pressure of the liquid bronze they are destined to contain.

The chamber and flues are formed principally by molding on suitable patterns, the casing (which should be made so as to be readily taken apart and rejoined) corresponding to flasks in molds for ordinary casting. The opening *e* in the cover of the chamber admits the melted bronze at the proper time. A furnace for melting the bronze is also requisite, but as it need not possess any peculiarity, it will be unnecessary to describe it.

The preparations for the commencement of the process of soldering consist in inclosing the wound wire in the case prepared for it, (the muzzle end placed upward,) the arrangements described for ascertaining when the proper heat shall have been reached,

and placing the gun-case with its contents in the gun-chamber, as represented by the dotted lines in Fig. 4.

Anthraxite coal may be used for fuel, and is supplied by the occasional removal of the cover (*h*) of the fire-place. Small openings, (not shown in the figure,) through the wall and casing of the gun-chamber, permit the observation of the comparative progress of the heat at the top and bottom of the mass being heated, which serves as an indication for properly regulating the draught. The openings are provided with slips of mica or glass to prevent the entrance of air when in use, and with means of preventing the escape of bronze in the later part of the process. The upper end of the case and its contents will of course heat more rapidly than the lower, and an indication of that fact will be found in the descent of one of the rods seen through the glass tube before mentioned, when the bronze on which it rested (near the top) has become fused. The bronze to be used as a solder is now to be made ready for pouring, and, as soon as the second indicating-rod is seen to fall, run into the gun-chamber through the opening *e*. It enters the gun-case at the opening *g*, in the bottom, and the flow must be continued until the melted metal has risen to a height sufficient to cover the wire, with some allowance for contraction in cooling.

The draught from the fire, it will be seen, is cut off by the closure of the flue *d* by the liquid metal. It is re-established across the upper part of the chamber by pushing in the brick *k*, fitted at the outset for removal. By this means the upper part of the case and the metal contained are kept at a heat which insures the cooling of the lower part of the mass first; a condition desirable for insuring the perfect solidity of the bronze. In order to lessen as much as possible the amount of bronze employed, the space about the gun-case within the chamber should be made as small as will suffice for properly conveying the heat from the fire. Judging from past observation, one inch will be ample for an 8-inch gun.

It will also be desirable, in large guns, to place within the core an iron tube nearly filling its cavity, closed at the bottom and supported by the steel bar forming the lower termination of the core. This would allow cooling from the interior, if desirable.

Provision must of course be made for preventing the wire from floating in the bronze, but it will hardly be necessary to particularize the means.

The oxidation of the case and the adhesion of the bronze to it may be almost entirely prevented by coating it with a wash containing common clay and pulverized anhydrous borax.

When the contents of the furnace have cooled sufficiently the casing of the gun-chamber is removed, and then the walls of the chamber itself. The envelope of bronze may be removed from the gun-case either before or after the mass is taken to the lathe. The ends of the block of united wire and bronze are first turned down, to show with precision the proper points for centering, and afterward the gun is bored and finished much in the ordinary way.

It is proposed to conform the model of the gun in some respects to the mode of manufacture. The proposed model is represented in Fig. 6. The termination of the bore at the rear is made somewhat conical, following in part the contour of the inner layer of wire. The trunnions, which are formed of the bronze filling the recesses *c d* in the gun-case, are shorter, and larger in diameter, than in guns of the common model. The vent enters the bottom of the bore in the line of the axis of the gun, extending but a short distance in the rear of its inner orifice; its course is bent at a right angle, and it reaches the exterior of the gun through a steel vent-plug. If desirable a platina vent-piece may be very securely inserted at the inner orifice by excavating the forward end of that part of the core mentioned as being preferably made of steel, (*a*, Fig. 1.) to receive the block of platina before the soldering.

For rifle-cannon in which a soft metal is forced into the grooves by the action of the powder in giving rotation to the projectile, it is proposed that the grooves should terminate just in advance of the position of the expanding metal in the loaded gun, and attain their depth gradually at a short distance (say one-third of a caliber) farther forward. The object is to prevent the escape of gas through the grooves before the soft metal has fully expanded.

For rifles of very large caliber, at least, I propose the plan successfully tried by me at Fort Monroe in 1850, with a little modification of form. The hinder part of the iron portion of the projectile is tapered toward though not quite to the rear, (which is a little enlarged,) and receives a ring of soft brass, which may be cast upon it, and which has its outer surface fitted, with a proper allowance for easy loading, to the bore of the gun, including the grooves. A deep circular channel may be made in the base of the ring to aid the expansive action.

Fig. 7 will assist in giving a more exact idea of the projectile. Rotation is imparted to the body of the projectile through the friction of the ring upon it, under pressure of the fired powder.

This rotation being less instantaneously communicated than it would be if the metal taking hold of the grooves were rigidly attached, the strain and friction, both in the grooves of the gun and on the projections entering them, are diminished. Of course,

guns designed for use with this projectile will need to have the grooves carried as far back as the forward end of the cartridge.

Whether steel or the hard bronze proposed to be used in these guns would prove the more desirable material for the walls of the bore can, perhaps, be determined only by experiments, but it may be well to remark that the solid union between the metals employed in this process would remove all objection to forming the bore in a comparatively thin steel tube, on which the wire might be directly wound.

Dimensions of proposed 8-inch rifle.

Diameter of bore, 8 inches.

Length of bore, 138 inches.

Whole length of gun, 150 inches, (12½ feet.)

Greatest diameter, 24 inches.

Diameter of trunnions, 10 inches.

Length of trunnions, 3½ inches.

Weight of gun, about 14,000 pounds.

While it is believed that a gun of the above dimensions would be fully able to sustain a large number of discharges with projectiles of 200 pounds, and charges of 50 pounds of powder, it would doubtless be a great advance on results yet attained to produce a gun capable of proper endurance with charges of 30 or even 25 pounds powder and projectiles of full weight. It may, therefore, be suggested as the part of prudence to make the first tests with the lower charges, and subsequently to employ the largest.

L. B. No. 4.]

ARMY BUILDING, NEW YORK, July 10, 1872.

SIR: I am directed by the board on heavy cannon to write to you, stating that the board has been informed that there is at your post a piece (or pieces) of an experimental gun, taken from one made by Doctor W. E. Woodbridge several years ago, and experimented with. If this information be correct the board requests that you will forward these specimens to it, together with such information as you can furnish relating to them.

By direction of the board.

• Very respectfully, your obedient servant,

C. E. DUTTON,

First Lieutenant Ordnance, Recorder.

Major J. G. BENTON,
Commanding Springfield Armory.

No. 15.]

NATIONAL ARMORY,
Springfield, Massachusetts, July 11, 1872.

DEAR SIR: In answer to your letter of the 10th instant, I have to reply that no specimens from the Woodbridge trial gun can be found at this armory.

A specimen taken from near the muzzle of this gun was submitted to the Ordnance Office in 1862 or 1863, which, according to my recollection, had a tenacity of 110,000 pounds per square inch. This specimen was left by me in the War Department, where it got mislaid, and could not afterward be found. The trial gun made by Doctor Woodbridge at the Washington navy-yard was tested here, and afterward sent to the Ordnance Office, where I understand it now is.

Your obedient servant,

J. G. BENTON,

Major Ordnance, Commanding.

Lieutenant C. E. DUTTON,
*Board on Heavy Guns, New York City,
Care Colonel Crispin, Ordnance Agency.*

No. 43.]

NEW YORK, July 16, 1872.

SIR: I have the honor to present herewith a general description of the plan of constructing heavy ordnance proposed by me, respectfully requesting that it may be submitted to the board.

If any further details shall be desired I will gladly present them, either verbally or in writing.

I am, sir, very respectfully, your obedient servant,

W. E. WOODBRIDGE.

General R. H. K. WHITELEY,
President Board on Heavy Ordnance.

[Inclosure.]

Plan proposed by W. E. Woodbridge for the construction of heavy cannon.

The material of which the gun is to be principally composed is steel wire, drawn square, with the corners slightly truncated.

This is to be wound on a steel tube, in successive spiral layers. A sufficient number of wires are to be wound at once to form, when placed side by side, a band about equal in width to the diameter of the intended bore of the gun, which will give them the proper obliquity.

The tube is to be closely covered in this way from end to end, and with layer after layer, until the mass has reached the size of the intended gun.

The whole is then inclosed in an air-tight case of boiler-iron, and, thus protected from oxidation, is heated to the melting point of bronze, when liquid bronze is supplied so as to interpenetrate the mass, and, when cooled, unite it in one solid piece, to be afterward turned and finished to the proper form and dimensions.

Steel of a rather low degree of carbonization, (such as will take but little temper,) is considered best for making the wire to be employed. An excellent quality has been obtained both from Messrs. Cooper, Hewitt & Co., of Trenton, and from Messrs. Hussey, Welles & Co., of Pittsburgh. The large demand for steel wire which has arisen during the last comparatively few years has led to increased skill in the selection of ingots, and to its production with great uniformity of quality. If it were necessary, the possession of the requisite properties in each piece of wire might be determined with very considerable accuracy by twisting a piece 2 or 3 inches long in a simple machine which would show at once the force required for a given angular torsion, and the limit of its capacity to twist. The size I have been led to prefer is three-tenths of an inch square.

The steel tube on which the wire is to be wound should at least be thick enough to permit being rebored to the proper caliber and rifled without cutting through it, (as it would be undesirable to have the surface of the bore present two metals,) some allowance being made for a slight possible swaging or warping in the process of construction. In some instances it may be desirable to increase the thickness of the tube, the only objection in any case being the substitution of the inferior metal of the tube for the stronger material surrounding it. The length of the tube should exceed the intended length of the gun, and it should be provided at each end with a flange, screwed on, the flanges being serviceable for fastening the ends of the wires and for security in handling after winding. It should also be closed at the breech-end, and for a muzzle-loader the diameter of the metal may be reduced in the rear of the bottom of the bore.

For winding, the tube is rotated in a lathe or winding-machine, and the wires drawn between friction-plates which are carried with a regulated motion in a line parallel with the tube.

In heating, the closed end of the tube is placed downward.

The trunnions of the gun may consist of bronze employed in the process, spaces for receiving the metal being provided within the case, protecting the wire from oxidation.

The heating-chamber, in which the case inclosing the wound wire and tube is placed before the application of heat, is no larger than is requisite to afford sufficient space for the draught from the furnace to convey the heat from the furnace with proper rapidity, an inch on all sides being enough for a very large gun.

The flue bringing the heat from the furnace should enter the chamber at the top, above the protecting-case, and the flue by which the gases leave the chamber should have its beginning at the bottom, but should be carried up near the side of the chamber to about the level of the entering flue. The walls of the chamber and flues must, of course, be composed of refractory materials, and they must also be incased in iron of such thickness as to enable them to sustain a column of metal of a depth equal to their height. They may conveniently be formed of ground fire-brick, with a small admixture of clay, moistened and rammed around patterns of proper form.

For the purpose of ascertaining the progress of heating, and when the proper temperature shall have been obtained, pieces of bronze, on which perpendicular rods may rest, are placed within the tube, one at the bottom and another near the top. A tube, extending from the top of the protecting-case through the cover of the heating-chamber, and fitted with a glass tube at its top, permits the upper ends of rods standing on the pieces of bronze before mentioned to be seen. The dropping of the rods will indicate the melting of the pieces by which they are supported.

The fluid bronze for uniting the wires is admitted through the bottom of the case. The opening for this purpose is provided with a short tube, projecting downward into a shallow iron cup properly secured in place. This tube is plugged with bronze until, in the progress of heating, the plug is melted from its place, when, being received in the cup, a liquid valve or trap is formed, preventing access of air to the interior of the case, but ready to admit the melted bronze when poured into the heating-chamber.

Pouring the metal, of course, cuts off the draught from the fire by closing the flue

leading from the chamber. As it is desirable that the upper end of the gun should cool last, provision is made for re-establishing the draught through the upper part of the heating-chamber.

The advantages of a proper distribution of initial strains may be gained by cooling from the interior, in the manner practiced by the late General Rodman with cast-iron guns, and it is proposed to employ a current of air for that purpose.

I refrain from discussing here the theory of this mode of construction, but will very respectfully refer the board to some of the practical results as shown in the small gun made at the Washington navy-yard, and finally tested by Colonel Laidley at Springfield. Colonel Laidley's report is supposed to be before the board.

L. B. No. 18.]

ARMY BUILDING, NEW YORK,
July 16, 1872.

GENTLEMEN: I am directed by the board on heavy cannon, now in session in this city, to inquire of you at what price you can furnish steel wire three-tenths inch square, in large quantity; what tenacity you would estimate it to possess; and whether you have made any experiments to determine whether the tenacity is injured by keeping the wire at a red heat for four or five days; if so, what are the results of these trials.

Very respectfully, sir, your obedient servant,

C. E. DUTTON,
First Lieutenant Ordnance, Recorder.

Messrs. COOPER & HEWITT.

No. 46.]

NEW YORK, July 19, 1872.

DEAR SIR: We have received an answer to your letter of 16th instant from our manager, from which it appears that experiments would be necessary in order to give exact answers to your questions. In a general way, however, we would recommend the use of Martin steel as the most uniform in quality, if, as we suppose, the wire is to be used for the manufacture of cannon.

The tenacity of the soft steel may be safely estimated at 125,000 pounds per square inch.

The experiments, however, would probably show a higher range, especially if the wire is hard-drawn.

We have made no special experiments in order to determine the effect of exposing the wire to a red heat for four or five days, but can readily do so.

Our general experience, however, is sufficient to enable us to say that the tenacity of the wire would be reduced by such exposure, but how much would be a matter of conjecture.

Assuming that the wire is to be accurately drawn, and all defective pieces rejected, we think that the price would be about 16 cents per pound.

We regret that we cannot be more precise in our answer, but, if the board desires, we will, with pleasure, institute a series of experiments which will serve to give exact information.

We have the honor to be, very respectfully, your obedient servants,

COOPER, HEWITT & CO.

Captain C. E. DUTTON,
Recorder, &c., Army Buildings.

L. B. No. 25.]

ARMY BUILDING, NEW YORK,
July 18, 1872.

SIR: The board on heavy cannon respectfully request that you will forward for its information the report of Lieutenant-Colonel Laidley upon the trial of Dr. W. E. Woodbridge's gun at Springfield Armory in 1865.

Very respectfully, sir,

R. H. K. WHITELEY,
Colonel of Ordnance, President of Board.

THE CHIEF OF ORDNANCE.

No. 44.]

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, July 19, 1872.

SIR: Complying with your request of 18th instant, I send herewith a copy of Colonel Laidley's report upon the trial of Dr. W. E. Woodbridge's gun at Springfield Army in 1865.

Respectfully, your obedient servant,
By order of the Chief of Ordnance.

S. V. BENÉT,
Major of Ordnance.

The PRESIDENT OF THE BOARD ON HEAVY ORDNANCE.

No. 44.]

NATIONAL ARMOY,
Springfield, July 15, 1865.

SIR: I have the honor to report that, in obedience to your orders of March 6, I have tested the steel-wire and bronze gun of Dr. W. E. Woodbridge, and I inclose herewith tabular statements* of the number of rounds and charges used, and the corresponding enlargements of the bore, together with sketches of the gun and projectile.

For the facility of mounting the gun I chased a thread on its exterior surface and screwed on a band to which trunnions were welded; the band was $4\frac{1}{2}$ inches wide and .625 inch thick. The gun was then mounted on an old field-carriage. The gun had, when the firing commenced, a projecting vent-piece of steel, and a Dahlgren chamber.

At the one hundred and sixty-seventh round the vent-piece broke off, and it was observed that the bore was elongating rapidly, so that I deemed it proper to bore out the chamber, to fill it up with a copper plug, and move the vent forward some three inches inserting a copper vent-piece.

After the twentieth round a crack was observed in the bore, running from the muzzle along the edge of a groove, five inches in length.

At the four hundredth round a small crack was observed in the rear side of the trunnion-band.

After the one thousandth round the vent-piece had started, and was replaced by a new one.

At the one thousand one hundredth round the trunnion was so much bent as to render the elevation of the gun difficult; and at the one thousand three hundred and twenty-seventh round the trunnion-band opened and the gun recoiled out of it, striking a wooden building with such force as to go through its side.

The bore is much worn at the seat of the shot, particularly on its upper half surface, in the grooves, where holes are worn to the depth of .35 inch and 1 inch in length. The core-piece at the muzzle is much burned, and has a honey-combed appearance.

The greatest enlargement of the bore, in rear of the seat of the shot, caused by the one thousand three hundred and twenty-seven rounds of excessive charges, is only seven thousandths of an inch, and there are, as yet, no indications of the gun giving way in any part.

It was intended to carry the trials further but for the breaking of the trunnion-band; it is, however, believed that the object of the experiment to test the strength and endurance of the gun has been already fully attained, and the strength and endurance of the gun abundantly demonstrated.

Very respectfully, I am, sir, your obedient servant,

T. T. S. LAIDLEY,
Major of Ordnance, Commanding.

Brigadier-General A. B. DYER,
Chief of Ordnance, Washington, D. C.

* Target-record of firing omitted from this publication.

[Inclosure.]

Measurements of the bore of Dr. Woodbridge's wire gun.

Distance.	Diameter of bore before firing.	Diameter of bore after firing—								
		50 rounds.	100 rounds.	150 rounds.	200 rounds.	250 rounds.	300 rounds.	350 rounds.	400 rounds.	450 rounds.
24	2 514	2 516	2 516	2 518	2 517	2 518	2 518	2 518	2 518	2 518
23.5	16	16	17	18	18	19	19	19	19	19
23	17	17	16	19	19	19	19	19	19	19
22.5	16	17	17	18	16	18	18	18	18	19
22	15	16	12	17	14	17	17	17	17	18
21.5	14	13	13	16	13	16	15	16	16	16
21	13	16	12	15	13	16	14	14	15	15
20.5	12	12	12	14	13	13	14	14	14	14
20	12	12	12	13	13	13	13	13	13	13
19.5	11	10	10	13	11	14	13	13	13	13
19	11	11	10	13		14	13	13	13	14
18.5	11	11		13		13		13		13
18	10	11		13						
17.5	10			12						
17	10			12						
16.5	9									
16	9									
15.5	9									
15	9									
14.5	9									
14	9									
Muzzle										

Distance.	Diameter of bore before firing.	Diameter of bore after firing—								
		500 rounds.	550 rounds.	600 rounds.	650 rounds.	700 rounds.	750 rounds.	800 rounds.	850 rounds.	900 rounds.
24	2 514	2 520	2 520	2 520	2 521	2 520	2 520	2 520	2 520	2 520
23.5	16	21	20	20	22	22	22	22	22	22
23	17	21	21	21	22	22	22	22	22	22
22.5	16	19	19	20	21	20	21	21	20	20
22	15	18	19	19	20	19	19	20	19	19
21.5	14	17	17	18	18	18	17	18	17	18
21	13	16	16	16	17	17	17	17	17	17
20.5	12	15	16	16	17	17	17	17	17	17
20	12	14	16	15	17	16	16	17	16	16
19.5	11	14	15	15	17	16	16	16	16	15
19	11	14	15	14	16	16	16	15	16	15
18.5	11	14	15	14	16	16	16		16	16
18	10									
17.5	10									
17	10									
16.5	9									
16	9									
15.5	9									
15	9									
14.5	9									
14	9									
Muzzle										

Measurements of the bore of Dr. Woodbridge's wire gun—Continued.

Distance.	Diameter of bore before firing.	Diameter of bore after firing—								
		950 rounds.	1,000 rounds.	1,050 rounds.	1,100 rounds.	1,150 rounds.	1,200 rounds.	1,250 rounds.	1,300 rounds.	1,337 rounds.
24	2.514	2.520	2.520	2.521	2.520	2.520	2.521	2.521	2.522	2.522
23.5	16	22	22	23	22	21	23	23	23	23
23	17	22	22	23	22	22	23	23	21	23
22.5	16	22	21	22	21	22	22	22	23	23
22	15	20	19	23	20	21	20	20	20	22
21.5	14	18	17	23	18	19	18	19	20	20
21	13	17	17	23	17	18	18	18	18	18
20.5	12	17	16	18	17	18	17	17	18	18
20	12	17	16	18	17	17	17	17	18	18
19.5	11	16	16	17	16	16	17	17	17	16
19	11	16	.....	18	22	17	17	20	20	21
18.5	11	17	.....	18	32	20	19	23	24	24
18	10	.....	.....	21	.....	20	21	21	23	23
17.5	10	.....	.....	21	.....	.....	20	21	23	.....
17	10	.....	.....	.....	.....	.....	70	22	23	.....
16.5	9	.....	.....	.....	.....	.....	12	21	24	.....
16	9	.....	.....	.....	.....	.....	19	70	25	.....
15.5	9	.....	.....	.....	.....	.....	20	.....	30	.....
15	9	.....	.....	.....	.....	.....	19	.....	30	.....
14.5	9	.....	.....	.....	.....	.....	21	.....	50	.....
14	9	.....	.....	.....	.....	.....	21	.....	31	.....
u zlc	.....	.....	.....	.....	.....	.....	48	.....	.....	48

No. 62.]

NEW YORK, July 25, 1872.

SIR: I have the honor to present herewith the estimate requested, of the cost of constructing a 12-inch rifle on my plan. It is intended to include all items of expense, but I cannot suppose myself to have so far excelled engineers in general as to make it prudent to neglect a "factor of safety."

It is, of course, also necessary to be borne in mind that accidents are more liable to occur in new processes (however perfect in principle) than in those long practiced, and in which trained men may be employed.

It shall be my endeavor (if the work is undertaken) to bring the expenses within the estimate; but I would be sorry to be limited to those figures.

Very respectfully, your obedient servant,

W. E. WOODBRIDGE.

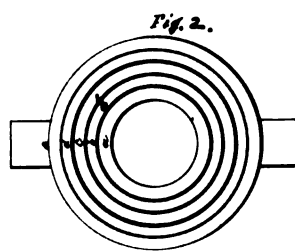
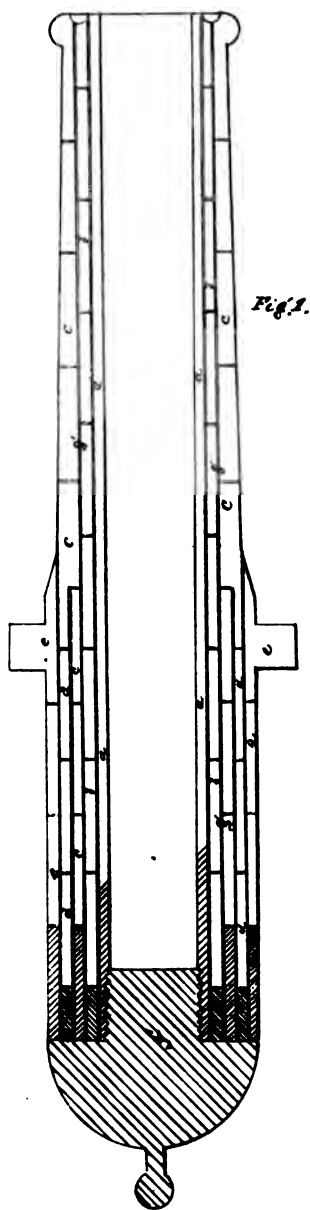
General R. H. K. WHITELEY,
President Board on Heavy Ordnance.

[Inclosure.]

Estimate of cost of 12-inch rifle on the plan of W. E. Woodbridge, at Washington navy-yard.

Wire, 60,000 pounds, at 14 cents.....	\$8,400 00
Steel tube, including duty, freight, and exchange.....	3,400 00
Bronze, half of 30,000 pounds, employed, at 34 cents.....	5,100 00
Draughting and pattern-making.....	1,500 00
Adaptation of lathe to winding.....	1,200 00
Wire-reels, stands, and appendages, (40 reels).....	1,400 00
Wire-joining tools.....	125 00
Case for protecting wire, 5,000 pounds, at 17 cents.....	850 00
Iron-work for heating-chamber, 10,000 pounds, at 13 cents.....	1,300 00
Iron-work for heating-furnace.....	525 00
Fire-bricks for heating-chamber, 6,500, at \$57 per thousand.....	142 50
Ground fire-brick for heating-chamber, 100 pounds, at \$4.....	400 00
Fire-clay for heating-chamber, 25 pounds, at \$2.....	50 00
Fire-bricks for heating-furnace, 2,500, at \$57 per thousand.....	142 50
Common bricks for heating-furnace, 9 000, at \$15 per thousand.....	135 00
Lime, 9 barrels, \$20; sand, 3 yards, \$6.....	26 00

LEMUEL W. WRIGHT
Improvement in Ordnance.



Masons' labor on heating-furnace, chamber, and flues	\$150 00
Hoisting-apparatus in ordnance-foundry	600 00
Carpentry, \$150; adaptation of melting-furnace, \$100.....	250 00
Blower, tubing, and connections with portable engine.....	500 00
Fuel, 30 tons anthracite or equivalent, at \$10.....	300 00
Labor not included in items above	2,000 00
Incidental expenses, (minor freights, cartage, oils, &c.).....	500 00
Tests for selection of steel and bronze	500 00
Finishing gun, including special tools	2,750 00
Total	32,474 00

Cost of 8-inch rifle, weight 17,000 pounds.

	Independ- ently.	With 12- inch rifle.
Wire, 17,000 pounds, at 34 cents	\$2,380	\$2,140
Tube, ($\frac{3}{4}$ of 12-inch)	1,000	1,000
Bronze.....	1,360	1,360
Drawings and pattern-making	1,300	500
Adaptation of lathe and wire-reels	2,400	.....
Wire-joining tool.....	125	.....
Case for protecting wire	425	425
Iron-work on heating-chamber.....	780	780
Iron-work on heating-furnace	315	.....
Bricks, &c., for heating-chamber	300	100
Bricks, &c., for heating-furnace	200	.....
Masons' labor	100	50
Adaptation of melting-furnace	100	.....
Hoisting-apparatus.....	500	.....
Carpentry	100	.....
Blower and connections	400	.....
Fuel.....	120	120
Labor not included in items above	1,500	600
Tests for selection.....	500	.....
Incidental expenses.....	375	50
Finishing the gun.....	850	850
Total.....	15,130	7,975

LEMUEL W. WRIGHT.

Lemuel W. Wright's improvement in ordnance, No. 55,193, patented May 29, 1866.

Be it known that I, Lemuel Wellman Wright, a resident of Thorndike, in the county of Hampden, and State of Massachusetts, have made a new and useful invention, having reference to cannon or ordnance; and I do hereby declare the same to be fully described in the following specification and represented in the accompanying drawing, which denotes a longitudinal section of a cannon made in accordance with my invention.

The nature of my said invention consists in a series of concentric cylinders of wrought iron or steel, brazed together to form a cannon in the manner hereafter shown.

In carrying out my invention, or, in other words, constructing a piece of ordnance in my improved manner, I first make a cylinder or tube, *a*, of wrought iron or steel, of a proper length and thickness, according to the size of the gun I intend to make. Next, I form a series, *b b*, &c., of rings or tubes of twelve inches in length, more or less, from rolled-iron plates, and place such tubes concentrically upon the central tube *a*, the said tubes *b* having such an internal diameter as to be easily slipped upon such tube *a*. I next make another series, *c c*, &c., of tubes, of an internal diameter sufficient to allow them to be slipped upon the former series, and so dispose them as to cause the latter to break joints with them. This operation I repeat with series *d d*, &c., *e e*, &c., of larger tubes, until I have acquired the proper thickness for the gun. These tubes should all be "lap-welded."

I make the breech, *f*, of the gun of solid iron or steel, and with a boss to fit into the central tube or cylinder, such boss having a male screw formed upon it to screw into a female screw made on the inner surface of the tube *a*, as shown in the drawing. I next put on a tube or ring, having the trunnions welded to it. This having been accomplished, I next "pickle" the mass or series of tubes in diluted sulphuric acid, for the purpose of cleaning the surfaces of the tubes from oxide, scales, and other impurities.

Next I splice the embryo gun in a vertical position on a movable truck, or other suitable device, and while in such position I coat both the internal and external surfaces of the gun with plastic clay, so as to entirely insulate it from the atmosphere, and after such clay has become dry the truck with the gun is to be run into a furnace made for the purpose, and having a temperature such as will soon raise the metallic tubes of the gun to a red heat, or such heat as will not allow the melted solder, or metallic compound *g*, which is to be poured into the upper ends of the series *b c d e*, of tubes, to become chilled. The fluid metal, or solder, should be poured into such tubes until, aided by gravitation and attraction, it shall have permeated all the spaces between the series of tubes or rings and the central tube, and so as to form a solid mass of brass and iron, after the same may have been cooled.

I claim an improved cannon, or piece of ordnance, as made with the breech *f*, the central tube *a*, and one or more series of tubes or concentric cylinders, arranged and combined substantially as specified; the whole being united or brazed together in the manner substantially as set forth.

LEMUEL W. WRIGHT.

L. B., No. 52.]

ARMY BUILDING, NEW YORK, *August 13, 1872.*

SIR: You are respectfully requested to furnish the board on heavy cannon an estimate of the cost of making a 12-inch rifle, according to the plan proposed by you, including the cost of plant.

Your obedient servant,

C. E. DUTTON,
Lieutenant Ordnance, Recorder.

LEMUEL W. WRIGHT, Esq.

NEW YORK, *August 29, 1872.*

SIR: I have the honor to acknowledge the receipt of your letter of the 13th instant requesting me to furnish the board on heavy cannon an estimate of the cost of making a 12-inch rifle, according to the plan proposed by me, including the cost of the plant.

In compliance with that request I beg to submit the following estimate:

Cost of materials for one 12-inch gun.....	\$4,000
Cost of labor for one 12-inch gun.....	4,000
Cost of plant, not including buildings, but including rent and power	39,000
Contingent expenses of all kinds	13,000
Total, gun and plant	60,000

The same plant will do for making all sizes of guns, up to 20 inches diameter, and will be sufficient to make one gun per week.

I have the honor to remain, very respectfully, your obedient servant,

L. W. WRIGHT.

Lieutenant C. E. DUTTON, *United States Army,*
Recorder Board on Heavy Cannon, Army Building, New York.

[Indorsement.]

WASHINGTON ARSENAL, *September 2, 1872.*

Respectfully referred to the Chief of Ordnance with the suggestion that this paper be filed with the records of the board on heavy cannon.

C. E. DUTTON,
First Lieutenant Ordnance.

G.

Proceedings of a Board of Ordnance Officers, convened to recommend the place, manner, and details of the construction of the heavy guns selected by the board instituted under the act of June 6, 1872.

Proceedings of a Board of Ordnance Officers, convened at the Ordnance Office, September 24, 1872, in pursuance of the following order:

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, D. C., September 18, 1872.

Orders:

A board of ordnance officers will assemble at the Ordnance Office, Washington, D. C., on the 24th instant, in order to determine and fix the place, manner, and details of

the construction of the guns selected by the board recently in session under General Orders No. 57, Adjutant-General's Office, 1872.

Detail for the board.—Lieutenant-Colonel T. T. S. Laidley, Major J. G. Benton, Major S. Crispin, Major T. G. Baylor, and Captain S. C. Lyford.

By order of the Chief of Ordnance:

S. V. BENÉT,
Major of Ordnance.

FIRST DAY.

The board met at the Ordnance Office, at 2 p. m. on Thursday, the 24th day of September, and the above order having been read, the members being all present, the board proceeded to business.

On motion it was resolved to ask the Chief of Ordnance to place before the board the report of the board on heavy ordnance recently in session under the act of Congress approved June 6, 1872, with such other information as he might think necessary to a proper understanding of the subject on which the board was in session. (Copy appended, marked I.)

The subject of the place of manufacture of the gun invented by Dr. Woodbridge being under discussion, it was determined to ask, through the Chief of Ordnance, permission to visit the Washington navy-yard to personally inspect the facilities there offered for the construction of this gun. (Copy appended, marked II.)

The board then adjourned at 3.30 p. m., to meet to-morrow at 10 a. m.

SECOND DAY.

SEPTEMBER 25.

The board met pursuant to adjournment, all the members present.

The proceedings of the preceding day were read and approved. The board then continued the discussion of the preceding day, viz, the place of constructing the Woodbridge gun.

Dr. Woodbridge being present, was invited to personally submit his views on the character and details of his proposed gun, with any other information he might desire to place before the board, which invitation he accepted.

The board received a letter from Rear-Admiral Case, Chief of Bureau of Ordnance, United States Navy, addressed to Rear-Admiral L. M. Goldsborough, commandant of the Washington navy-yard, requesting him to extend the courtesies of the yard in accordance with the request contained in letter appended marked II.

Pending the discussion on the Woodbridge gun the board adjourned, at 3.30 p. m., to meet at the navy-yard to-morrow morning at 10.30 a. m.

THIRD DAY.

SEPTEMBER 26.

The board met, pursuant to adjournment, at the Washington navy-yard, all the members present, and through the courtesy of Rear-Admiral L. M. Goldsborough, commanding, and Commander M. Sicard, in charge of the ordnance department of the yard, personally inspected the facilities offered at the yard to construct a Woodbridge muzzle-loading rifled gun. The inspection being finished, the board took a recess, to meet at the Ordnance Office.

The board after recess met at the Ordnance Office at 1 o'clock p. m., all the members present.

The proceedings of the preceding day were read and approved, and the discussion of the preceding day was then continued.

The board informed Mr. Hitchcock by telegraph of their desire to see him. (See copies of correspondence marked III and IV.)

Pending the discussion of the Woodbridge gun, at 3.30 p. m. the board adjourned to meet to-morrow at 10 a. m.

FOURTH DAY.

SEPTEMBER 27.

The board met pursuant to adjournment, all the members present.

The proceedings of the preceding day were read and approved.

The board then continued the discussion of the Woodbridge muzzle-loading rifled gun. Pending the arrival of information asked for, the board proceeded to discuss the subject of the Hitchcock wrought-iron muzzle-loading rifle, Mr. Hitchcock being present and submitting his views as to the plan and place of construction. It was concluded, after consultation, to advise Mr. Hitchcock to visit Watervliet arsenal and Springfield armory, and personally view the facilities offered at either place for the construction of his gun; after such visits Mr. Hitchcock to again appear before the board.

The Woodbridge question was then taken up and discussion continued.

At 3.30 p. m. the board adjourned to meet to-morrow at 10 a. m.

FIFTH DAY.

SEPTEMBER 28.

The board met pursuant to adjournment, all the members present.

The proceedings of the preceding day were read and approved.

The board then took up the subject of the proposed conversion of the 10-inch Rodman guns into rifles of not less than 8 inches and not greater than 9 inches in caliber, by the introduction of a steel or wrought-iron tube, as recommended by the board on heavy ordnance of which Colonel R. H. K. Whiteley, Ordnance Department, was president. It being necessary to interrupt this discussion while certain drawings were being prepared, the board took up the recommendation of the board on heavy ordnance above referred to in relation to a trial of the French and Swedish breech-loading system of rifled converted guns, and after discussion unanimously adopted the following resolution, viz :

Resolved, As the approved recommendation of the board on heavy ordnance, organized under the act of Congress approved June 6, 1872, regarding the details of the construction of a representative gun on the French and Swedish breech-loading system, by the conversion of a 10-inch smooth-bore Rodman gun, is contingent upon the results of the experiments and tests with the conversion of the Rodman guns of this caliber into muzzle-loading rifles, also ordered to be tested, that no action can be taken by this board on this question ; but it is recommended that, when the gun is constructed, that the work be done at the West Point or the South Boston Foundry, as the Chief of Ordnance may deem best. It was also—

Resolved, That, in regard to the 12-inch Krupp rifled gun, recommended by the board on heavy ordnance, organized under the act of Congress approved June 6, 1872, and approved by the Chief of Ordnance and Secretary of War, no action by this board is deemed necessary.

Pending the discussion on the conversion of the Rodman guns, the board adjourned at 3.30 p. m., to meet on Monday, the 30th instant, at 10 o'clock.

SIXTH DAY.

SEPTEMBER 30.

The board met pursuant to adjournment. All the members present.

The proceedings of the preceding day having been read and approved, the board proceeded to business.

Dr. Woodbridge being present, further consultation was had in relation to the manufacture of his gun.

After careful consideration of the subject of the place, manner, and details of the construction of the Woodbridge gun, Dr. Woodbridge assenting unequivocally to the views of the board, it was—

Resolved, That a preliminary gun of smaller caliber be made on Dr. Woodbridge's plans, for the purpose of giving the necessary experience to the workmen to construct the 12-inch gun determined upon.

The following resolution was then unanimously adopted, viz :

Resolved, That the board recommends that the gun to be constructed on the Woodbridge plan, as recommended by the board on heavy ordnance, organized under the act of Congress approved June 6, 1872, for experiments and tests, be of 12 inches caliber without preponderance ; and that the other dimensions be as fixed in the appended drawing, marked V ; that a Woodbridge gun of 9 inches caliber be made prior to the 12-inch gun, in form and dimensions as shown in the appended drawing, (marked VI ;) that both guns be constructed at the Frankford arsenal ; that all other details of construction, (understanding that the steel tube to be used be not less than 1 inch nor more than 2 inches in thickness,) and selection, and tests of materials be intrusted to Dr. Woodbridge, who shall receive such compensation for his services and expenses as may be agreed upon between the Chief of Ordnance and himself ; that the commanding officer of Frankford arsenal furnish all material, labor, and other necessary facilities for the prosecution of the work, under authority of the Chief of Ordnance, and keep a record which shall furnish a complete history of the details of the construction of these guns.

In response to invitation, Mr. Sutcliffe appeared before the board, and presented his views as to the construction of his gun.

Pending the discussion on this subject, the board adjourned at 3.15 p. m., to meet at 10 a. m. to-morrow.

SEVENTH DAY.

OCTOBER 1.

The board met pursuant to adjournment. All the members present.

The proceedings of the preceding day were read and approved, and the resolutions in the case of the Woodbridge gun were read in presence of Dr. Woodbridge, who ex-

pressed himself as satisfied as to the place, manner, and details of the construction of his gun.

Mr. Nathan Thompson being present, after consultation on the subject of his proposed breech-loading rifled gun, it was determined to address a letter to him, asking his views, and answer to the question as to whether he was prepared to adopt the recommendation of the board on heavy ordnance, (copy appended, marked VII.)

A telegram was received from Mr. Hitchcock, (appended, marked VIII,) stating that the Springfield Armory or Watervliet arsenal would be a suitable place to make his gun.

The board then took up the subject of the Hitchcock gun, and, after free and full discussion, the following resolutions were unanimously adopted, viz:

Resolved, That the board recommends that the wrought-iron muzzle-loading rifled gun, to be constructed on the Hitchcock plan, as recommended by the board on heavy ordnance, organized under the act of Congress approved June 6, 1872, for experiments and tests, be of 12 inches caliber, without preponderance, and that the other dimensions be as fixed in the appended drawing, (marked IX;) that the gun be made at the Springfield Armory, or at the Watervliet arsenal, as the Chief of Ordnance may elect; that all other details of construction, and selection, and tests of materials, be intrusted to Mr. Hitchcock, who shall receive such compensation for his services and expenses as may be agreed upon between the Chief of Ordnance and himself; and that the commanding officer of the armory or arsenal, as the case may be, provide all material, labor, and necessary facilities for the prosecution of the work, under authority of the Chief of Ordnance, and keep a record which shall furnish a complete history of the details of the construction of this gun.

Resolved, If Mr. Hitchcock deem it important that a gun of smaller size be constructed prior to the manufacture of the 12-inch gun, to give the necessary skill and experience to the workmen, he be allowed to make a 9-inch gun of the form and dimensions shown in the appended drawing, (marked X,) under the same conditions as above expressed in relation to the 12-inch gun.

Mr. Sutcliffe then submitted his views on the subject of his gun to the board; pending the discussion of which, the board, at 3.30 p. m., adjourned till to-morrow at 10 a. m.

EIGHTH DAY.

OCTOBER 2.

The board met pursuant to adjournment. All the members being present.

The proceedings of the preceding day having been read and approved, the subject of the Sutcliffe breech-loading gun was taken up, and the following resolution was unanimously adopted:

Resolved, That the board recommends that the Sutcliffe 8-inch breech-loading cast-iron gun, lined with a steel tube, as recommended by the board on heavy ordnance, organized under the act of Congress approved June 6, 1872, be made in accordance with the drawing appended, marked XI, the details of the breech-loading part having been approved by Mr. Sutcliffe; that two breech-blocks be made, one for the use of the Broadwell ring, and the other for a gas-check placed in the block itself; that the gun be made at the West Point or South Boston Foundry, as the Chief of Ordnance may direct; and that Mr. Sutcliffe be employed to superintend the construction of the breech-loading device, with such compensation as may be agreed upon between the Chief of Ordnance and himself.

The board then proceeded to discuss the subject of the conversion of the 10-inch Rodman smooth-bore guns, and, after careful deliberation, unanimously adopted the following resolution, viz:

Resolved, That the board recommends, in the conversion of the four 10-inch smooth-bore Rodman guns, recommended by the board on heavy ordnance, organized under the act of Congress approved June 6, 1872, for experiments and tests, that two be made of a caliber of 8 inches, one tubed from the front and one from the rear, and two of a caliber of 9 inches, one tubed from the rear and one from the front; that the dimensions and details of construction be as given in the drawings appended, (marked XII, XIII, XIV, and XV;) that the guns be altered at the West Point or South Boston Foundry, as may be determined by the Chief of Ordnance; that the tubes be made in Europe, at establishments competent to do the work, and that the supervision of the conversion be intrusted to some officer or officers of the Ordnance Department, to be selected for the purpose by the Chief of Ordnance.

The board then adjourned, at 4 p. m., to meet to-morrow at 9.30 a. m.

NINTH DAY.

OCTOBER 3.

The board met pursuant to adjournment. All the members present.

The proceedings of the preceding day having been read and approved, the board

took up the subject of the Nathan Thompson gun, Mr. Thompson presenting his answer to the letter addressed to him, (marked VII,) which is appended, (marked XVI.) The latter having been read, and the subject having been discussed, the board concluded to address Mr. Thompson a letter to remove any misapprehension which he might labor under in relation to the proposed construction of his gun, (appended, marked XVII,) and allow him to modify his letter, (marked XVI,) if he should desire to do so.

Awaiting an answer to this letter from Mr. Thompson, the board adjourned, at 4 p. m., to meet to-morrow at 10 a. m.

TENTH DAY.

OCTOBER 4.

The board met pursuant to adjournment. All the members present.

The proceedings of the preceding day having been read and approved, and the board having waited twenty-four hours for Mr. Thompson to reply to the letter, (marked XVII,) and no reply having been received, the following resolution was unanimously adopted, viz :

Resolved, That the board recommends, in the event of Mr. Thompson consenting, to have a rifled breech-loading gun constructed on his plan, as recommended by the board on heavy ordnance, organized under the act of Congress approved June 6, 1872, for experiments and tests, an 8-inch cast-iron rifled gun, lined with a steel tube, to be constructed in accordance with such plans as Mr. Thompson may submit to the Ordnance Department; that the gun be made under the supervision of Mr. Thompson, at an appropriate place, to be determined by the Chief of Ordnance and himself, the expenses to be borne and controlled by the United States, and Mr. Thompson to receive such compensation for his services as may be agreed upon between the Chief of Ordnance and himself.

The board then adopted the following resolution unanimously :

Resolved, In order that the Department may have the benefit of all experiments that may be made between this and such time as the guns shall be ready for trial, in determining the details of the rifling and venting of the guns to be made under the recommendation of the board on heavy ordnance, organized under the act of Congress approved June 6, 1872, the board recommends that the subject of rifling and venting be deferred until the guns shall be ready for these operations, when a board of officers shall be convened to decide these questions.

There being no further business before the board, the board adjourned, at 12 m., *sine die*.

T. T. S. LAIDLEY,
Lieutenant-Colonel of Ordnance, President.
J. G. BENTON,
Major of Ordnance.
S. CRISPIN,
Major of Ordnance, Brevet Colonel, U. S. A.
T. G. BAYLOR,
Major of Ordnance.
S. C. LYFORD,
Captain of Ordnance, Recorder.

[Indorsement of the Chief of Ordnance on the report of the board.]

ORDNANCE OFFICE, October 9, 1872.

Respectfully submitted to the Secretary of War, with the recommendation that the Woodbridge, the Sutcliffe, the Hitchcock, and the Thompson guns be made, out of money now applicable to the manufacture of heavy rifled ordnance, for experiment; that all of these guns be 12-inch rifles, and that they be made of the materials and in the manner to be determined by the respective inventors, who shall have control, and direct how their respective inventions shall be made; the guns to be made under the supervision of the Ordnance Department, and where it may direct their manufacture; each inventor to be allowed a per diem compensation while superintending or directing the work, the amount to be fixed by the Ordnance Department. The procurement or manufacture of the 10-inch converted Rodman guns, and the 12-inch Krupp breech loaders, which have been recommended by the board, to be postponed until it shall have been ascertained that there will be sufficient of the funds remaining for their procurement.

It is recommended that, when procured, it shall be in the following order, viz, four converted 10-inch Rodman guns, and one 12-inch Krupp breech-loader.

A. B. DYER,
Chief of Ordnance, United States Army.

[Indorsement of the Secretary of War.]

Approved:

WM. M. BELKNAP,
Secretary of War.

OCTOBER 16, 1872.

Documents appended to the report of the board of ordnance officers convened to recommend the place, manner, and detail, of the construction of the heavy guns selected by the board instituted under the act of June 6, 1872.

I.

ORDNANCE OFFICE, WAR DEPARTMENT,
September 24, 1872.

SIR: The board convened, by your order of September 18, 1872, to determine and fix the place, manner, and details of the construction of the guns selected by the board recently in session under General Orders No. 57, Adjutant-General's Office, 1872, being now in session, have the honor to request that you will place before them the record of the proceedings of the said board on heavy ordnance, with the final action thereon, and such other papers as may be thought necessary to a proper understanding of the subject upon which this board is convened.

Respectfully, your obedient servant,

T. T. S. LAIDLEY,
President of the Board.

The CHIEF OF ORDNANCE,
Washington, D. C.

II.

ORDNANCE OFFICE, WAR DEPARTMENT,
September 24, 1872.

SIR: Being desirous of ascertaining the best locality for the construction of some experimental guns recommended to be tested, under the act of June 6, 1872, the board requests that it may be permitted to examine the facilities in this respect at the Washington navy-yard, provided any facilities at that station may be available for the purpose.

It accordingly requests that the Navy Department may be conferred with in this regard, and permission obtained from that Bureau to make the necessary examination.

Respectfully, your obedient servant,

T. T. S. LAIDLEY,
Lieutenant-Colonel of Ordnance, President of the Board.

The CHIEF OF ORDNANCE, U. S. A.,
Washington, D. C.

III.

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, September 26, 1872

ALONZO ITCHCOCK,
H West Fifty-fifth Street, New York:
The board wish to see you here. Answer.

T. T. S. LAIDLEY,
Lieutenant-Colonel, President Board.

IV.

[*Western Union Telegraph Company, New York, September 26, 1872. Received at Washington September 26, 12.30.*]

T. T. S. LAIDLEY, *Ordnance Department* :

Will be in Washington to-morrow morning.

ALONZO HITCHCOCK.

VII.

ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, October 1, 1872.

SIR: By direction of the board of ordnance officers, convened at this office by order of the Chief of Ordnance, to determine upon the place, manner, and details of the construction of certain guns recommended by the board on heavy ordnance, organized under the act of Congress approved June, 1872, to be constructed for experiments and tests, I have to inform you that the said board, in regard to the gun presented by you, substantially resolved not to accept the propositions made by you, but recommended the construction by the United States of a cast-iron 8-inch rifled gun, lined with a steel tube, for experiment and tests, on your plan, you consenting to the recommendations, and you to submit the details of construction for approval of the War Department.

I therefore have the honor to request of you in writing a definite answer as to whether you accept the recommendation as proposed and are prepared to submit the required plans.

The board will be glad to have your views upon this subject at as early a date as possible.

Respectfully, your obedient servant,

S. C. LYFORD,
Captain of Ordnance, Recorder.

Mr. NATHAN THOMPSON, *Present.*

VIII.

New York, October 2, 1872.

DEAR SIR: I have made such examination as to satisfy myself that there are good foundations at either Watervliet or Springfield for the erection of this plant for forging heavy guns.

As a matter of convenience for working the forge when built, the location at Springfield might be preferable, inasmuch as there is a bluff there, into which the forge might be set, that would bring the furnace floor on a level with the ground on top of the bluff. This would certainly be convenient for the delivery of the material to be used, such as coal and iron, on a level with the furnaces.

But it is suggested that it would not cost much to hoist the materials one story, say 20 or 25 feet, if the forge was put up in the end or corner of the forging shops, where there is plenty of power available at that point, costing comparatively nothing.

The same argument is applicable to Watervliet, as in that location all the materials would have to be elevated, but with this additional advantage—a good stack and boilers are ready for use.

I believe this is all that your board expects me to say in regard to the locations, and I am now ready to go on with the working drawings, but it will make some difference whether or not we adopt Mr. Sellers's hammer, or construct one especially for the business. It might be well to see Mr. Sellers first, as it would be necessary for him to make some alterations. We could save time, no doubt, by ordering a hammer from him, but we could build one more suitable for the business, and probably for much less money.

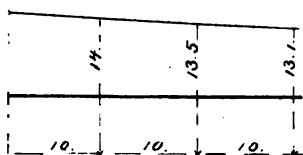
I also think it would be well for me to go to Pittsburgh soon and see about getting those rings manufactured, but I shall wait for a personal interview or suggestion from your honorable board.

Yours, respectfully, &c.,

ALONZO HITCHCOCK,
408 West Fifty-fifth Street.

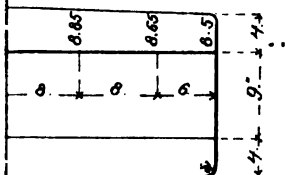
Colonel T. T. S. LAIDLEY.

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Adopted by
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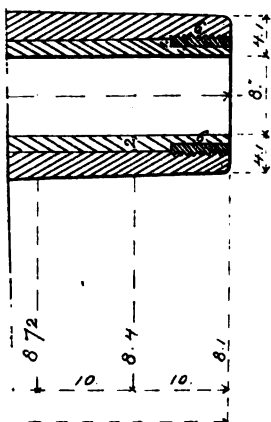
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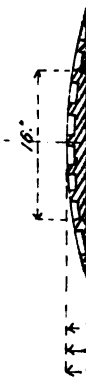
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XVI.

METROPOLITAN HOTEL,
Washington, D. C., October 3, 1872.

CAPTAIN: I have the honor to acknowledge the receipt of your communication under date of the 1st instant; also copy of a resolution passed by the board of heavy ordnance relating to my system of breech-loading.

Believing, as I do, the resolution above mentioned inconsistent with the letter and spirit of the act of Congress making appropriation for testing heavy rifled ordnance, in which category an 8-inch gun can hardly be placed, and by which act I know it was intended to test my system, I must respectfully decline to accept the "recommendation as proposed" in its present shape. Neither can I jeopardize the result of years of study, labor, and expense incurred in working out the problem, by placing the test of my system out of my hands, and regret that the board should do me the injustice to expect me to submit at once the full details for a gun of a caliber not heretofore considered, giving me neither time nor opportunity to avail of facilities I possess here and abroad which I am confident will guarantee the success of my system.

In justice to myself and to the interests I represent in this matter, I must respectfully enter my protest against the action of the board, which, if final, leaves me no alternative than to fall back upon my original application to Congress.

Respectfully, your obedient servant,

NATHAN THOMPSON.

Captain S. C. LYFORD,

Recorder, Board of Ordnance, Washington, D. C.

XVII.

OFFICE OF THE ORDNANCE BOARD,
ORDNANCE OFFICE, WAR DEPARTMENT,
Washington, October 3, 1872.

SIR: Referring to your letter of this date, in reply to the letter of the board addressed to you on the 1st instant, in relation to the proposed construction of your gun, the board directs me to say that you appear to have misapprehended the tenor of the letter of the board above referred to.

The board did not intend, nor does it now intend, to take the construction of the gun out of your hands; but, on the contrary, if the 8-inch gun shall be built, it will be constructed on your plans, under your direct supervision, by the United States.

Nor did the board intend to hasten you in submitting the details of your plan, but only intend to have an early reply to the question as to whether you accepted the proposition recommended by the board on heavy ordnance.

Be pleased to give the board an early reply as to whether you wish to modify your letter of this date.

Respectfully, your obedient servant,

S. C. LYFORD,

Captain of Ordnance, Recorder.

NATHAN THOMPSON, Esq., *Present*.

REPORT OF THE CHIEF SIGNAL-OFFICER.

REPORT OF THE CHIEF SIGNAL-OFFICER.

WAR DEPARTMENT,
OFFICE OF THE CHIEF SIGNAL-OFFICER,
Washington, D. C., October 1, 1872.

SIR: The instruction of the Army in military signaling and telegraphy during the past year has been limited to that had at the Signal-School of Instruction at Fort Whipple, Virginia, the Military Academy at West Point, and in the Department of the Missouri.

Irregular instruction has been given by partially instructed officers at isolated posts in other departments, but it has been of so imperfect a character that it cannot properly be taken into account in summing up the results of the year's labor. In this connection the Chief Signal-Officer desires to reiterate the views expressed in his annual report of last year, of the necessity of providing thoroughly instructed officers in the several military departments, who shall have charge of the duties of instruction connected with the signal-service, in these departments, subject to the direction of the Chief Signal-Officer. Until this plan is adopted the instruction must necessarily be given without thorough system or responsibility.

At Fort Whipple the course of study described in previous reports has been followed by such officers of the Army as have been ordered for instruction during the year. No change has been made in the text-books, except by the addition recently of a work on military telegraphy, prepared under the direction of this Office.

The number of officers instructed and the amount of field-practice had by each are shown in tables 1 and 2 herewith.

The drills of the detachment with arms have been thorough, and have been carefully conducted.

Practice has been had in field telegraphy and in the duties of the detachment, with the field telegraphic train; but it has been quite irregular owing to the want of animals for the train, and until recently of sufficient ground for the train maneuvering. The transfer of a portion of the Arlington reservation to the charge of this office has removed the latter obstacle. It is hoped that the necessary animals will be soon provided in order that this important branch of signal duty may receive the attention it deserves. Additional improvements in the several train-wagons are contemplated, to increase still more their efficiency.

The duties of the signal-service in the branch of military telegraphy have become so recognized in their importance wherever that armies are maintained or serve, that the Chief Signal-Officer does not longer feel it necessary to urge the advantage of a proper organization and practice of this duty. It is by constant effort only the service of the

United States will now be able to keep pace with its rapidly improving progress elsewhere, and, in case of war, to have within itself the nucleus on which to develop a military telegraphy fit for the uses for which it will then be certainly required; that the knowledge and skill had by the enables the service to be employed in many ways for the public benefit, in time of peace, has been sufficiently demonstrated.

A principal duty of the post has been in this year, as in the last, the drill and instruction of the observer-sergeants and the assistant observers, who are here fitted for the intelligent performance of their duties. All candidates for either of these positions are selected from the enlisted men of the signal detachment, for which, after careful examination, they have been first enlisted as privates, and in the duties of which they are regularly drilled. The soldiers seeking the positions of sergeants are required to present satisfactory recommendations as to conduct and general fitness from the officer in charge of the post, and to pass a second preliminary educational examination before they are placed under especial instruction. Classes are formed, and are supplied with the standard text-books on military signaling, telegraphy, and meteorology, and pursue a regular course of study and for recitation as marked out in these books. They are taught the practical use of the various meteorological instruments, forms, &c., in use at the several stations of observation, and station-duties generally, so far as they can be taught with the facilities of the post. They are practiced, at the same time with the rest of the detachment, in the regular drills and duties of the service. When a soldier is considered competent as an assistant, and has been so reported by the instructor at the post, he is ordered, as vacancies occur, as an assistant observer to a station. Here, in addition to perfecting himself in the practical details of the duties at the station, he continues his studies, reciting systematically to the observer-sergeant in charge. A service of six months in this capacity favorably reported upon renders an assistant eligible as a candidate for promotion. He may then be ordered back to the school to review thoroughly the whole course of study and practice, under the direction of the instructor, and to appear for an examination before a board of officers convened for the purpose. Passing this examination, he is considered competent to take charge of a station, and is promoted to the grade of observer-sergeant as vacancies occur. This course has been followed successfully during the past year. The fitness of each man has been clearly determined by this probationary service before his assignment to a responsible position. The total number of assistants instructed since last report is seventy-six (76). Thirty-seven (37) assistants have completed the full course of drills and study, and have passed the required examinations as observer-sergeants. The number of enlisted men examined for the position of assistant has been one hundred and seventy-eight (178). Fifty per cent. of the applicants have failed to come up to the standard of examination. (Tables 3 and 4.)

The instruction at Fort Whipple is under the immediate direction of First Lieutenant C. E. Kilbourne, acting signal-officer and instructor, who has devoted himself assiduously to the discharge of the duty, and by whom it has been well conducted.

Second Lieutenant C. C. Wolcott, acting signal-officer, was in charge until April 11, 1872, at which date he was succeeded by Lieutenant Kilbourne.

The fact that very few men reported for final examination have failed to pass successfully reflects credit upon both officers.

The experience of the Office has confirmed the views hitherto expressed,

that the varied subordinate duties in its charge could be rendered by no other class of men so successfully as it is by those who, drilled and practiced as soldiers, continue in its service as non-commissioned officers, habits of fidelity and prompt obedience, with pride in their especial organization. The tests of good qualities, endurance, and capacity given by military discipline are hard ones, and those who have passed them approved rarely evidence that they have been defective. The experience had in the control of themselves and others in the regular and strict discharge of duty becomes invaluable when the charge of stations devolves upon either assistants or sergeants.

The board of examiners for assistant observers has consisted of Brevet Lieutenant-Colonel Garrick Mallery and Brevet Captain H. W. Howgate, acting signal-officers. The board of examination for observer-sergeants has been constituted of these officers with the addition of the instructor, now First Lieutenant Charles E. Kilbourne, acting signal-officer. The sessions of both boards are held at this Office, that for assistants meeting weekly; that for observer-sergeants being convened by order whenever necessary.

The condition of Fort Whipple has been materially improved since the date of the last annual report, by the construction of a well appointed hospital, large enough for the present wants of the command.

The Secretary of War having ordered the construction of new quarters and a mess-hall for the men, a guard-house, and a stable at the post, these buildings are well advanced toward completion, and will be ready for occupation before the winter season opens. To obtain suitable space for the erection of these structures it was necessary to demolish a part of the fortifications, and this work has fallen heavily upon the detachment. Buildings are now urgently needed for officers' quarters and for purposes of instruction. Those now occupied are both inconvenient in size and dilapidated beyond repair, and it is recommended that suitable provision be made for the construction of others to replace them. Several changes were made in the immediate charge of the post prior to May 28, on which date First Lieutenant R. P. Strong, Fourth United States Artillery, and acting signal officer, was assigned to this duty. Under his energetic administration several important changes in the management of the post have been made, and the efficiency of the detachment has materially increased. The importance of the proper maintenance of Fort Whipple, well equipped as a post of instruction, can hardly be estimated. It is here alone, in the service of the United States, that either officer or enlisted man can be thoroughly taught the especial duties of the signal-service. At no other post or place is there the time or the facilities for the study and continued practice to properly qualify the officer to be an acting signal officer, nor can enlisted men be elsewhere drilled and practiced in all the branches of the service.

The morning report of Fort Whipple, on September 30, shows thirteen non-commissioned officers and ninety-six privates on duty at that post.

Instructions in military signaling and telegraphy have been given to a limited extent to the first and second classes of cadets at the Military Academy at West Point, but the reports received have not been sufficiently full to render a detailed report practicable. The recommendation made in previous reports, that this duty be made a special branch of instruction, with a merit value given to it affecting the standing of the cadets, is renewed. The fact that during the past year the military representatives of several foreign governments have made the signal-

service of the United States Army a matter of especial study shows the importance attached to this branch of military science by those governments, and the necessity of constant work in this country to keep in advance of progress abroad.

The instruction in the Department of the Missouri has been regularly maintained, and the results show a commendable amount of energy on the part of the officers who have been in charge. Second Lieutenant V. A. Goddard, Sixth United States Cavalry, was assigned to duty as acting signal-officer of the department by the general commanding, relieved by the same authority March 27, 1872, and succeeded on that date by Second Lieutenant Philip Reade, Third United States Infantry, who still remains in charge. Neither of these officers has been regularly instructed at the school of instruction. Their labors have, however, been productive of good, by the general dissemination given a knowledge of the elements of signaling. In this department twenty-five officers are reported completely instructed, and eighty-two as partially instructed during the year, and fifty-nine enlisted men are reported as completely, and one hundred and fifty-four as partially instructed during the same period. The reports rendered by Lieutenant Reade are regular in form and promptly rendered, and the work in this department is in marked contrast to that of other military departments.

The purchase and issue of such signal equipments as have been needed in the different military departments have been made.

In connection with the instruction of the Army in the duties of this office, reference is made to papers A and B, herewith annexed, which have been issued in their present form during the year—the former for the first time, and the latter in a corrected and enlarged form.

DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

In the division of telegrams and reports for the benefit of commerce and agriculture, the service has continued upon the general plans and with the organization minutely explained in the last report. At each of the principal lake, sea-port, and river cities at which there are stations, the stations have been maintained during the year. The display of bulletin reports; of reports at the river stations, giving the rise and fall of the principal rivers; of the large weather maps, showing by changing symbols the meteoric changes at the different reports; and finally, at designated stations, the exhibition of day or night signals on occasions of supposed especial danger, have been regularly made. The reports have been lessened at some points by embarrassments beyond the control of the Office.

The following is a detailed account of the operations of each station from which reports have been had during the year ending September 30, 1872:

ALPENA, MICHIGAN.

The office is on the second floor of a three-story brick building at the corner of Fletcher and Dock streets, and is near the telegraph office from which the reports are sent. The roof of the building occupied is flat and covered with tin, and affords a good exposure for the wind-vane, anemometer, and rain-gauge.

The station was opened on the morning of September 10, 1872, since which date reports have been transmitted to Detroit, from which place they are sent to Washington, and distributed to the principal lake ports. The station is in charge of Sergeant F. P. Bayes, and is supplied with a full set of standard instruments, all of which are in good condition.

Latitude of station..... 45° 05'
Longitude of station..... 83° 30'
Elevation of barometer above sea-level..... 616 feet.

The instrument shelter is built in accordance with the authorized plan of the Office, and projects from a window on the east side of the room. A northern exposure could not be had.

No reports are received at this station, and consequently no bulletins are issued.

AUGUSTA, GEORGIA.

[Latitude, 33° 28'; longitude, 81° 53'.]

The office at this station was removed, May 1, to the third floor of a large building on the corner of Broad and McIntosh streets. The removal was made upon the recommendation of the meteorological committee of the Board of Trade, to secure more room for the performance of the observer's duties, and to get a better location and exposure for the instruments. The station is provided with a large wind-vane of the standard Signal-Office pattern, and one of Gibbon's self-registering attachment to the Robinson anemometer, in addition to the usual supply of standard instruments. The shelter projects from a window, and is well arranged.

Sergeant James R. Allen was relieved from the charge of the station October 7, 1871, by Sergeant Nathan D. Lane, who still remains, and is assisted by Private Frank Mangels. Both men are favorably mentioned by the officer who inspected the station in March, 1872.

Full reports from all stations were received here, and bulletins issued regularly, until June 30, 1872. Since that date the only reports received have been those from the Western Gulf stations and Shreveport. Copies of these are regularly furnished the local press, and selections from them published. The probabilities issued from the central office in Washington, in the afternoon of each day, are received and published in the morning papers of the day following. During the year ending September 30, 1872, two thousand nine hundred and ninety-two bulletins have been issued, and nine hundred and four reports furnished to the press. All station reports have been forwarded with regularity and in satisfactory shape.

The following table shows the meteorological condition of the station during the year:

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.005	66	1.62	Southeast.
	November.....	30.090	54	7.78	West.
	December.....	30.230	47	4.98	Northwest.
1872..	January.....	30.160	41	5.20	Northwest.
	February.....	30.000	46	5.87	West.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
1872..	March.....	30.090	50	<i>Inches.</i> 10.88	Northwest.
	April.....	30.100	66	2.95	South.
	May.....	30.03	74	5.36	West.
	June.....	30.04	79	4.77	Southeast.
	July.....	30.05	81	6.87	South.
	August.....	30.07	80	4.10	East.
	September.....	30.08	75	1.33	West.
	Annual mean....	30.089	63.3	61.75	West.

. BALTIMORE, MARYLAND.

[Latitude, 39° 18'; longitude, 76° 36'.]

The location of the office at this station has remained unchanged since the date of last annual report, nor has any essential change been made in the exposure of instruments, or in instrument shelter. The anemometer has been provided with the standard self-registering attachment, and is elevated upon the telescopic rod devised at the central office, to secure a proper exposure of the instrument and to free it from the influence of surrounding objects.

Full reports were received from all stations, and maps and bulletins issued regularly, until June 30, 1872. From that date until August 21 no reports were received, and the only work done at the station was the transmission of the local observations directly to Washington. On August 21 the circuit system was again resumed, and full reports received and published in bulletin form. Maps to the number of thirty daily are sent from the central office, and are distributed at 2 o'clock each afternoon. During the year four thousand one hundred and ninety-nine maps and three thousand one hundred and thirty-five bulletins have been issued, and three thousand two hundred and seventy reports furnished to the press. The papers generally publish the synopses and probabilities as received through the Associated Press, and most of them publish a part, at least, of the tabular report. The weekly summary of the weather, and the monthly statements of the range of instruments, are also published by the leading papers.

The Board of Trade has appointed a meteorological committee, and its secretary, Mr. George U. Porter, has manifested a decided interest in the service. Nine cautionary signals have been displayed at this station during the year, five of which were fully justified.

Sergeant H. J. Penrod has remained in charge during the year, and has performed his duties in a manner satisfactory to this Office. All reports have been forwarded promptly and regularly. Private Wagg, the assistant at the date of last report, was relieved, December 20, 1871, by Private William Theodovius, who remained until ordered in for promotion, July 9, 1872. Private Otto Schutze is now on duty as assistant.

The station was inspected April 3, 1872, and reported in good condition; instruments in fine order, and records neatly kept.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30. 150	59	3. 11	Northwest.
	November.....	30. 08	45	3. 24	Northwest.
	December.....	30. 14	33	1. 90	Southwest.
1872..	January.....	30. 09	35	. 88	Northwest.
	February.....	30. 02	36	1. 46	Northwest.
	March.....	30. 06	37	3. 06	Northwest.
	April.....	30. 09	56	3. 06	West.
	May.....	30. 01	68	1. 44	Northwest.
	June.....	29. 97	75	4. 18	Southwest.
	July.....	29. 978	81. 2	1. 58	Southwest.
	August.....	30. 042	79. 3	4. 69	Southwest.
	September.....	30. 048	69. 5	5. 06	North.
	Annual mean....	30. 057	52. 2	33. 54	Northwest.

BOSTON, MASSACHUSETTS.

[Latitude, 40° 20'; longitude, 71° 03'.]

The office at this station remains at 103 Court street, where it was located at the date of last report. Full reports were received from all stations until June 30, 1872, and bulletins and maps issued regularly. From that date to August 21 the only reports received were those from Burlington, Portland, and Mount Washington, which were here transferred to New York. Since August 21, twenty-two reports have been received and published daily. Other reports will be added from time to time, as the telegraphic facilities increase.

During the year, three thousand one hundred and twelve maps and three thousand eight hundred and eighty bulletins have been issued, and two thousand two hundred and forty-six press reports furnished to the daily newspapers. Tabular reports, monthly statements, and synopses and probabilities have been published regularly by the press, and a general interest manifested in the service.

Mr. Gaffield, chairman of the meteorological committee of the Board of Trade, has displayed marked interest in the condition of the station, and rendered the office valuable assistance.

The anemometer has been supplied with the telescopic rod for additional elevation, and also with the standard self-registering attachment. The other instruments remain as at last report, and are in good condition. Sergeant H. E. Cole is still in charge of the station, and has performed his duties to the satisfaction of this Office, and is favorably mentioned by the meteorological committee of the Board of Trade in their annual report. Private William Black has been on duty as assistant since October 23, 1871, and is reported faithful and intelligent in the performance of his duties. All reports have been forwarded regularly and in proper form. Fourteen cautionary signals have been displayed at this station during the year. In reference to one displayed November 14, 1871, the report of the meteorological committee of the Board of Trade states as follows:

The cautionary flag was displayed at 3.15 p. m., and all vessels regarded the caution and remained safely in port, except the *Star of the East*, whose captain ventured out

and was obliged to put back, the predicted gale coming on with great fury at 12.10 a. m. of the next day. We need not add that one captain certainly will in future bear testimony to the value of the storm-signals, and will respect them implicitly.

In another part of the same report the committee make the following statement:

Captain Nash, commander of the underwriters' relief steamboat, told the chairman of your committee that he would never leave port with a vessel when the signal-officer predicted a coming dangerous storm or gale of wind. On one occasion, when the appearance of the sky to a superficial observer might seem quite threatening, Captain Nash, desiring to take a steamer out of port, applied to the signal-officer at Portland, and was assured that for twenty-four hours he would experience but light breezes, and a flurry of snow during the latter part of the time. Perfectly confiding in the signal-officer, he immediately left the port, proceeded for seventeen hours in almost perfect calm, then experienced the predicted flurry of snow, and reached his destination in safety.

The station was visited by an inspecting officer April 29, 1872, and found in proper condition.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October	30.041	54.2	5.88	Northwest.
	November	29.932	39.8	6.42	Northwest.
	December	30.015	28.39	3.38	Northwest.
1872..	January	29.938	27.53	2.11	Northwest.
	February	29.930	28.55	2.31	Northwest.
	March	29.931	26.40	4.05	Northwest.
	April	29.996	46.31	1.81	Northwest.
	May	29.917	57.17	3.29	East.
	June	29.930	67.61	4.84	East.
	July	29.950	74.45	4.00	Northwest.
	August	30.003	71.8	10.68	West.
	September	30.001	63.8	6.04	Northwest.
	Annual mean....	29.964	48.8	54.31	Northwest.

BRECKENRIDGE, MINNESOTA.

This station was opened April 10, 1872, by Sergeant C. A. Shaw, who still remains in charge. Reports are sent to Saint Paul, where they are transferred. No reports are received from other stations, and consequently no bulletins or maps are issued. The town is a small one, and the terminus of a branch of the Northern Pacific Railroad, and the office is located in a small frame building, where the instruments have a fair exposure. The instrument shelter is of the standard pattern, and was made at Saint Paul and shipped to this point.

Latitude of station..... 46° 16'
Longitude of station..... 96° 38'
Elevation of barometer above sea-level 1,069 feet.

The station is supplied with one barometer, one thermometer, one hygrometer, one anemometer, one rain-gauge, and one wind-vane, all of the standard pattern.

Meteorological summary.

Year.	Month.	Mean bar-ometer.	Mean ther-mometer.	Total rain-fall.	Prevailing wind.
1872..				<i>Inches.</i>	
	April	29.999	41	.....	Northwest.
	May	30.004	53	4.05	Southeast.
	June	29.920	65	5.10	Southeast.
	July	29.992	67.1	6.01	Southeast.
	August	30.023	65.1	1.78	Southeast.
	September	29.959	58.3	1.18	Southeast.
	Mean for 6 months.	29.983	58.2	18.12*	Southeast.

* For five months.

BUFFALO, NEW YORK.

[Latitude, 42° 53'; longitude, 78° 55'.]

No change has been made in the location of the office at this station since the date of the last annual report. Full reports from all other stations were received until June 30, 1872, and published in the customary manner in the form of maps, bulletins, and press reports. Owing to the want of telegraphic facilities, the transmission of reports to this station, in common with others on the lakes, was discontinued from July 1 to September 1, 1872. During this period the work of the station was limited to the transmission of the local reports and the transfer of those received from Canada, which are received here from Toronto. On the 1st of September the regular service was again resumed, and fifty reports are now received and published regularly. During the year, five thousand nine hundred and eighty-three bulletins and four thousand two hundred maps have been issued and distributed, and one thousand one hundred and ten reports furnished to the press for publication. The leading newspapers have published regularly the tabular reports, synopses, and probabilities, and weekly and monthly statements, and in other ways shown a desire to assist in the development of the service. The meteorological committee of the Board of Trade has assisted the observer in various ways, and its members manifest a lively interest in the work.

Twenty-five cautionary signals were displayed between October 29, 1871, and September 1, 1872, twenty of which are reported as having been fully justified. Under date of October 30, 1871, the observer reports:

Several vessels held in port during the day, although the wind did not exceed twenty miles per hour. The signal gave entire satisfaction, and may be considered a success.

November 10, 1871.—Signal for November 10, 1871, fully justified, and very generally regarded by mariners. A large number of vessels held in port until signal was lowered; gave entire satisfaction.

November 15, 1871.—An unknown amount of property, and perhaps a great many lives have been saved. The warning was given some fifteen hours before the full violence of the storm was felt at this station. It was heeded by all sailors, and no vessels left this port during its display. The storm was the most violent known on the lakes for years.

November 24, 1871.—Storm unusually severe; signal fully justified. No vessels left this port during its display.

September 25, 1872.—This warning was generally observed; no vessels leaving during

its display, except one schooner, which left on the morning of the 25th, but returned in a few hours, somewhat damaged. Among the lake men it was regarded as a very good hit.

September 30, 1872—This cautionary was observed by all classes of mariners. No vessels left the harbor during the time it was displayed, although seven were ready to start on the morning of the 29th of September, and would have done so if the signal had not been hoisted. There is no doubt in the minds of all but that a great many lives and an immense amount of property were saved by this cautionary signal, as the gale was very severe.

In his semi-annual report to this office of January 1, 1872, the observer remarks: "Tug captains probably give the weather-reports more attention than any other class of marine men, and proved very advantageous to them in calculating where to look for vessels which are due or in distress. The press of the city shows every disposition to give the service publicity, and promote its interests;" and on July 1, he reports: "The liveliest interest is now manifested by all classes of citizens in the service, and the office is thronged daily by visitors, commercial men, pleasure-seekers, &c., and the weather reports are relied upon." * * * "The demand for the reports was so great at the opening of navigation that the number used had to be very much increased—the weather maps taking precedence of bulletins." * * * "The display of cautionary signals is lauded in every instance, and no sailor risks his craft on the lakes while the signal is flying."

Sergeant Allen Buell was in charge of the station until relieved July 17, 1872, by Sergeant William McElroy. Both men have shown themselves energetic and well qualified to perform their duties. Private John Clark was on duty as assistant until February 16, 1872, when he was replaced by Private Taylor, who still remains and has given satisfaction. The station was inspected in the latter part of July, and found in good condition.

In addition to the instruments named in last-report, the station is provided with a large wind-vane of the standard pattern, and the telescopic rod and self-registering standard attachments to the anemometer.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.014	54.3	1.64	Southwest.
	November.....	29.997	34.7	3.60	Northwest.
	December.....	29.945	27.6	2.55	West.
1872..	January.....	29.965	26.4	1.94	West.
	February.....	29.940	25.7	2.21	West.
	March.....	29.968	27.2	1.30	West.
	April.....	29.950	45.7	1.43	Southwest.
	May.....	29.905	54.7	2.23	Southwest.
	June.....	29.894	66.3	3.52	Southwest.
	July.....	29.894	73.4	1.66	West.
	August.....	29.942	73.3	1.94	Southwest.
	September.....	29.921	64.6	4.34	Southwest.
	Annual mean....	29.942	47.8	28.36	Southwest.

The winds considered dangerous to navigation at this station are those from the northwest, with a velocity of twenty-five miles per hour and upward, and from the southwest from twenty miles per hour and upward.

BURLINGTON, VERMONT.

[Latitude, 44° 29'; longitude, 73° 11'.]

The location of the office at this station has not been changed since the date of the last report, nor is a change considered desirable at present. Reports have been sent from the station without interruption during the year, but since July 1, 1872, none have been returned. Two thousand and twelve bulletins have been issued. No reports were furnished the press.

The station was inspected in May, 1872, and the instruments and office found in good order. A large wind-vane, of the standard pattern, has been added to the instruments on hand at last report.

Sergeant George H. Ellery has remained in charge during the year, and has forwarded all the reports promptly, and given general satisfaction.

Owing to the fact that this is a station of observation and report only, and does not receive reports from other stations, the citizens feel less interest in its operations than they otherwise would.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.033	47.7	2.75	South.
	November.....	29.995	26.7	.73	Northwest.
	December.....	29.972	24.5	.78	South.
1872..	January.....	29.984	16.3	.42	South.
	February.....	29.905	19.2	.13	South.
	March.....	29.840	17.7	.13	South.
	April.....	29.803	42.7	.73	South.
	May.....	29.900	54.7	3.59	South.
	June.....	29.908	66.0	3.66	South.
	July.....	29.883	71.8	7.27	South.
	August.....	29.965	70.4	9.70	South.
	September.....	29.979	60.8	3.38	South.
	Annual mean....	29.931	43.2	33.27	South.

CAIRO, ILLINOIS.

[Latitude, 37° 00'; longitude, 89° 00'.]

The location of the office at this station remains unchanged. Previous to July 1, 1872, a sufficient number of reports were received to enable the observer to issue a map each morning, and the bulletins three times daily, but since that date the only reports received have been from the river stations in the afternoon, and but one bulletin is therefore issued. The total number of maps issued during the year is one thousand one hundred and fifty-two; of bulletins, four thousand one hundred and eighty-eight, and three hundred and sixty-six reports furnished the press.

On the 1st of January the observer began to make regular daily observations of the rise and fall of the Ohio River, using for that purpose the gauge constructed by the United States Engineer Corps. These

observations have been sent with each regular afternoon telegraphic report, and distributed with that report to all the principal cities on the western rivers.

The station has been inspected twice during the period covered by this report—once in November, 1871, and again in August, 1872. At the first inspection several of the instruments were found improperly located, and suitable changes were made. At the second inspection, the station was found in good working order.

Sergeant Thomas L. Watson has been in charge during the year, assisted by Private James M. Watson. Both men are favorably mentioned for their intelligence by the inspecting officers, and all the telegraphic reports from the station have been regularly transmitted; some delay has occurred in forwarding the mail reports.

The anemometer is provided with the standard self-registering attachment, and the small wind-vane on hand at last report has been replaced by a large one of the standard pattern.

The inspecting officer reports as follows, in reference to the interest taken in the service:

The citizens take a great interest in the weather service, and visit the office and the places where the maps and bulletins are posted daily, when the reports are received. The river reports are particularly valuable, and are studied with as much interest and profit as the market reports.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.122	60.3	3.81	Southeast.
	November.....	30.130	43.9	2.93	Northeast.
	December.....	30.230	34.5	4.25	Northwest.
1872..	January.....	30.270	31.3	1.44	West.
	February.....	30.063	37.9	2.26	North.
	March.....	30.150	43.4	2.02	Northwest.
	April.....	30.049	61.4	4.52	Southeast.
	May.....	30.054	68.7	5.00	Southwest.
	June.....	30.042	75.7	1.79	Southwest.
	July.....	30.028	79.8	3.45	South.
	August.....	30.079	80.2	.19	North.
	September.....	30.061	70.7	2.56	South.
	Annual mean.....	30.107	57.3	34.22	Southerly.

Extracts from observer's journal, February 9, 1872.—Slight shock of earthquake between four and five o'clock a. m., lasting about ten seconds; calm nearly all day with the exception of light north and west winds.

March 31, 1872.—The winter just passed is generally conceded to have been the severest in many years at this place, and has been chiefly distinguished by the remarkable and continued low stage of water in the rivers, and the frequency and severity of the "cold snaps" and the backwardness of spring. The blooming of peach-trees, just coming on during the last days of March, took place in the middle of February in the preceding year.

CAPE MAY, NEW JERSEY.

[Latitude, 39°, 00' ; longitude, 74° 58'.]

No change has been made in the location of the office at this station, nor is any considered desirable at present. No reports are received here, the station being used for observation and report and the display of cautionary signals only. Of the signals, twenty-two were displayed between October 28, 1871, and September 1, 1872, with satisfactory results. No bulletins, maps, or press reports have been issued. The station was inspected in April, 1872, and some irregularities in the manner of keeping and exposing the instruments corrected.

Sergeant T. F. Townsend remains in charge, and has given satisfaction by the promptness with which his reports have been forwarded and the neatness of his official papers. Since July 1, 1872, the midnight reports have not been forwarded until the succeeding morning, the telegraph office closing before the hour of making the observation. The transmission of the midnight cautionary signal orders is from the same cause rendered impossible.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing winds.
				<i>Inches.</i>	
1871..	October.....	30.15	59	4.91	South.
	November.....	30.04	43	6.42	Northwest.
	December.....	30.12	30	2.90	Northwest.
1872..	January.....	30.08	31.5	2.99	Northwest.
	February.....	30.01	31.7	2.99	Northwest.
	March.....	30.034	36.1	6.61	Northwest.
	April.....	30.070	48	.92	South.
	May.....	29.985	59.1	1.50	South.
	June.....	30.000	66.8	2.15	South.
	July.....	29.980	75.1	3.27	South.
	August.....	30.047	73.1	3.09	South.
	September.....	30.046	67.4	4.51	Northwest.
	Annual mean.....	30.047	51.8	42.26	Northwest and south.

CHARLESTON, SOUTH CAROLINA.

[Latitude, 32° 45' ; longitude, 79° 57'.]

The location of the office at this station remains unchanged. Full reports from all stations were received here until June 30, 1872, when their transmission was discontinued, owing to the want of proper telegraphic facilities. The reports from this station have been sent without interruption to the central office. During the year two thousand seven hundred and ninety-seven bulletins have been issued, and five hundred and eighty-six reports furnished to the press. No maps were printed at this station. The afternoon synopses and probabilities is the only one received here, and is printed in the morning papers of the succeeding day. The monthly summaries are published regularly. During the year four cautionary signals were displayed, two of which were fully justified, and the others partially so.

The station was inspected for the first time in July, and found to be in good general condition. Some slight irregularities in the exposure and care of instruments, and in the manner of keeping official records, were noted and corrected. This station is supplied with the large standard wind-vane, and with the telescopic rod and standard self-registering attachment for the anemometer.

Sergeant J. E. Evans remains in charge and has performed his duties satisfactorily. The inspecting officer remarks in his report upon the station:

The sergeant in charge is a faithful and intelligent man, and very zealous in the performance of his duties, with which he seems thoroughly acquainted. The station generally is in better working order than any I have visited. Both he and his assistant are spoken of in high terms by the presidents of the Board of Trade and Chamber of Commerce, and by the members of the meteorological committees.

Private J. O'Dowd was on duty as assistant until called in for promotion, April 22, 1872. He was succeeded by Private Sidney Powell, who still remains. In reference to the interest felt by the citizens in the service, the inspecting officer says:

The cotton interested portion of the community, perhaps more than any other class, take especial interest in the reports. Mr. Otlin, a leading cotton-broker, states that he has been governed to a great extent in his investments by the weather reports. Mr. Trenholm, ex-president of the Board of Trade, states that there is a general demand among cotton-growers for more stations in their respective districts, to the end that, if possible, the laws which govern the local rain-storms in those parts might be more fully comprehended, and the character and approach of such storms, which greatly influence the season, foretold with more certainty. The agricultural, even more than the mercantile, population in this section is interested in the state of the weather.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October	30.130	69	4.76	Northeast.
	November	30.06	59	4.09	Northeast.
	December	30.19	49	3.67	Southwest.
1872..	January	30.13	45	3.78	Northwest.
	February	29.994	48.5	5.13	Northwest.
	March	30.070	51	9.78	Southwest.
	April	30.111	65.6	2.46	East.
	May	30.023	74.9	6.30	Southwest.
	June	30.045	79.7	1.87	Southwest.
	July	30.056	84.1	2.30	Southwest.
	August	30.055	81.8	7.81	South.
	September	30.053	77.8	7.88	Southwest.
	Annual mean	30.076	65.5	58.83	Southwest.

CHEYENNE, WYOMING TERRITORY.

[Latitude, 41° 12'; longitude, 104° 42'.]

The office at this station was removed February 20, 1872, to the upper story of the building at the corner of Ferguson and Sixteenth streets, where it still remains. The shelter projects from a window, and is of the standard pattern. The exposure of the wind-vane, anemometer, and rain-gauge, on the roof of the building is good. Reports from ten sta-

tions were received here, and published in the authorized manner until June 30, 1872, when the failure of the telegraph company to carry out the plan of the Signal-Office caused their suspension. Arrangements were made, however, with another company to transmit the reports, and since September 1, 1872, the same number have been received as before the interruption. Reports from Denver and Santa Fé are received here and transferred to Chicago.

During the year eight hundred and forty-eight bulletins have been issued, and one hundred and sixty-two reports furnished the press.

Since January 1 the Cheyenne Leader has published daily a synopsis of the report immediately preceding the hour of publication. No maps are issued at this station.

The anemometer is provided with the standard self-registering attachment, and a standard wind-vane of the large size is in use. Sergeant A. C. Dobbins is still in charge of the station, and has conducted it since its establishment without an assistant, and without missing a single report. All reports have been forwarded punctually and in creditable form.

Meteorological summary.

Year.	Month.	Mean bar-ometer.	Mean ther-mometer.	Total rain-fall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	29.419	46.0	.24	West.
	November.....	29.384	28.9	.66	Northwest.
	December.....	29.418	28.0	.16	West.
1872..	January.....	29.929	26.6	.02	Northwest.
	February.....	29.859	30.9	.27	West.
	March.....	29.917	33.0	.38	Northwest.
	April.....	29.876	38.3	1.61	West.
	May.....	29.990	52.0	1.99	North.
	June.....	30.041	61.5	1.84	West.
	July.....	30.098	64.5	3.90	West.
	August.....	30.116	65.1	2.05	West.
	September.....	30.038	55.6	1.03	Northwest.
	Annual mean.....	29.840	44.2	14.15	West.

CHICAGO, ILLINOIS.

[Latitude, 41° 52'; longitude, 87° 35'.]

The great fire of October 8, 1871, destroyed the office and instruments at this station, and it was not until the 14th that a new location was obtained, with great difficulty, at No. 10 West Randolph street. In regard to the fire the observer, in his journal for October, 1871, says:

October 16, 1871.—Took possession of new office, No. 10 West Randolph street, yesterday. Have been without records from October 8 until to-day, everything official having been destroyed by the great fire, October 8 and 9. The observation at 10.53 p. m., October 8, was taken and transmitted as usual. At half past 9 an alarm of fire was rung. There had been a very large fire the preceding night, which was subdued with difficulty. The weather was intensely dry, and the wind blowing from the south-south-west with a velocity of about twenty miles per hour. Accordingly, when by 10 o'clock p. m. the fire had increased instead of diminishing, many people turned out to see it, not from alarm, but simply for the sake of the spectacle. At 10.30 the fire was still confined to two blocks, with a strong hold of only one. The firemen at this time seemed to have a fair chance of checking it, still the burning was so great as to enable one, by

the light of it, to read the time on the city clock, one-and-a-half miles distant. The wind was carrying the sparks right through the center of the city, the line lying only two blocks west of the city hall. Still no one felt alarmed, except those in the immediate vicinity. I myself was present, and had seen the much larger fire of the preceding night checked by the river. By 12 p. m. the fire had increased considerably in area and intensity, but as the wind was south-southwest, and the river ran due north and south, there seemed as yet but little danger for anything beyond the river. Hitherto the fire had been propagated, and with no great velocity, merely by contact with the flames, but toward 1 a. m. the heat of the fire had become so intense as greatly to increase the power of the wind in the immediate neighborhood of the flames. This was especially the case on the east and west of the fire toward the front, the wind blowing straight toward the fire in all directions. Within forty yards of the blaze I estimated the wind blowing from the east toward it at thirty miles per hour. This caused a decided whirling motion in the column of flame and smoke, which was contrary to the hands of a watch.

Blazing pieces of timber of considerable size were now whirled aloft, and carried to the north-northeast, starting new fires as they fell. These new fires being in the line of the smoke were invisible to those at the old fire. One of the fires was on the east side of the river, only a few blocks from the court-house. By 2 o'clock the court-house, with all the beautiful buildings around it, was in flames. The conflagration was now proceeding in the line of the wind as fast as a man could walk. By 3 a. m. the water-works, two miles to the northeast of the court-house, were burned. The city having been thus divided in two by a sheet of flame, the fire continued to work its way more leisurely to the east and west at right angles to the wind, as well as right in the teeth of it. The fire on the night of the 7th alone saved the West Division. It had burned two blocks in breadth down the west side of the river. The fire on the 8th originated only a few blocks further south, hence it could not progress north for want of material. On the east side of the river, in the south division, the fire continued to work toward the east; this it did with the greatest rapidity at the southern limit of the conflagration, because there the unburned houses broke the wind, and caused a back current at the base of the buildings. As soon as the fire had thus got a new swath of houses before it, and the wind behind it, away it went tearing, thus sadly surprising many who were congratulating themselves because the first rush of flame had spared them.

The Tribune people thought the strength of their building had saved them, because it lay at the extremity of one of the swaths. The next one took it. In the north division the first rush of the fire reached the lake, and then worked its way westward to the river. This it did not accomplish before 12 noon on the 9th. The wind had by 9 a. m. increased to perhaps twenty-five miles per hour, at the distance of three miles to the southwest of the fire. In the immediate vicinity of it, and especially in the streets running east and west, it was blowing with the force of a hurricane, lifting up on the north side whole burning-wooden buildings and pitching them on the tops of others. The wind, blowing in all directions toward the fire, confused some people in their endeavors to escape. This also caused the fire to progress along the tops of the buildings before the wind, and along the bases against the wind. The heat was intense. The buildings in front and at the sides of the fire began first to smoke from the heat radiating from the burning. Then, in many cases, without waiting for a tongue of flame to touch them, they would all at once burst into a blaze. To talk of fire-proof buildings in the midst of such a furnace is absurd. Steel was melted in innumerable cases, and stones and brick were burned to powder.

The firemen at first endeavored to check the fire in front. As soon as the fire had gathered in force this was not even to be thought of; not a single drop of water could reach the fire. The wind swept it aloft; besides, the firemen had to look out. Several of the engines which went to the front at first got burnt; others made futile efforts along the side of the fire, playing at right-angles to the wind. The fire ate in behind them, and they had to run. I saw several engines before the water stopped, doing nothing. At length they saw what they could do, and confined themselves to that. Letting the fire have free scope to the north and east, they endeavored to prevent it from spreading south against the wind. In this they succeeded, cutting it off just as it was preparing to lay hold of immense piles of lumber which lay along the river. This was done about 3 a. m. Monday. The efforts of the firemen, lamed for want of water, were ably seconded by gunpowder in the forenoon in the southern division. The same agent had been employed to check the northward progress of the fire, but in vain. Toward noon the further progress of the fire southward was thus checked. In the northern division it had reached its limits about the same time, having burnt everything that would burn, out as far as Lincoln Park, about four miles from the court-house.

The loss of life was greatest along the path of the first rush of fire; it came so sudden and unexpected. Only those who died in the streets have been recovered. The very bones of those who were in the buildings would be burned.

The observation-office lay right in the path along which the conflagration mowed

its first swath, from the southwest through the center of the city to the northwest. I went to the scene of the fire between 10 and 11 p. m., and did not think of the danger until too late. Kaufman was on duty, and saved the most valuable of the instruments, but only for a time. He carried them to his lodgings, which lay nearer the lake, and returned to find all the buildings around the office in a blaze. Thinking himself safe, he went back to his lodgings and went to sleep, and awoke in time to find the flames just upon him. Snatching his trunk, he escaped to the lake. Many trunks were lying there in flames, and he pitched his into the water. It might have been possible to have saved everything by procuring a vehicle at first; but vehicles were scarcely to be had. A jeweler, only a block from the observation-office, is said to have offered a thousand dollars for one in vain.

At 10 a. m. Monday I endeavored to find a telegraph-office, but could not; neither could I find a post-office. I wrote a letter and posted it in a letter-box. Early on the 10th I met an operator, who informed me where to find the telegraph-office; sent off a message, and left my address both at the post-office and telegraph-office; everything in confusion, and something like the fabled "state of nature" introduced. Citizens attacked with a supposititious incendiary mania; dangerous to go behind a house for any purpose. Found Kaufman.

On the 11th. waited; Sergeant Downes arrived.

On the 12th, found Sergeant Downes; reports sent in the afternoon.

On the 13th, endeavored to find a room of some sort; found that the price of rooms had trebled and quadrupled, especially in houses of any pretension.

On the 14th there was a considerable rain-fall, perhaps an inch; still continued in search after an office. An idea of the dearth of rooms may be obtained from the fact that when we sought to rent a room in Briggs' House, which has a very suitable roof, the proprietor informed us that he would be very happy to accommodate us, but that in the smallest of his rooms he had six persons sleeping at four dollars a head. Finally, for lack of a better, rented present office, No. 10 West Randolph street.

To-day, the 16th, the observations have been taken as usual, all except the velocity of the wind. We have no watches, and have sought in vain to procure a sand-glass.

October 17.—The secretary of the board of trade desires that the reports be bulletined as usual in the extemporized hall.

October 18.—Professor Lapham and Colonel Stone to-day visited the office. Colonel Stone, in fleeing from the fire, had his blanket burned on his back. Professor Lapham promised a table of corrections.

October 20.—Obtained a table of barometrical corrections for altitude from Professor Lapham.

October 23.—Commenced bulletining as usual. The Board of Trade meets in a low hall, hastily prepared; it is exceedingly crowded.

Instruments were sent from the central office immediately upon receipt of the telegraphic announcement of the disaster, but did not reach the observer until the 12th, upon which date reports were resumed and continued without further interruption, so far as sending was concerned, although it was some days afterward before full reports were received regularly, owing to the crowded condition of the telegraph lines leading into the city. A flag-staff for the display of cautionary signals was erected with as little delay as practicable, and a new printing-press for the issue of weather-maps sent from New York. The office was removed June 11, 1872, to No. 80 South Market street, where a room was leased for one year, with the privilege of renewal. The location was as good as could be obtained in view of the unsettled condition of affairs in the city at the time of its occupation, but recent changes in the telegraphic arrangements of the office have rendered it unsuitable, and a removal will be necessary at an early date. The present exposure of instruments on the roof is excellent, and the location is a favorable one for the display of signals. The large wind-vane, rain-gauge, and anemometer are on the roof, the latter instrument being elevated on a telescopic rod, and provided with the standard self-registering attachment. The instrument-shelter is of the standard pattern, and projects from a window facing the north, and contains a full supply of instruments. During the year there have been issued four thousand six hundred and five bulletins, and seven thousand eight hundred and fifty-four maps, and five thousand and twenty-three reports have been furnished to the

press. Previous to the fire, the leading papers published full tabular reports, but since that time they only appear occasionally.

The probabilities appear regularly when received; but, unfortunately, the midnight ones are sent very irregularly from New York, and the morning papers are compelled to use those issued the previous afternoon. Full reports were received here until June 30, 1872; from that date until July 29, 1872, the only ones received were those from the west, northwest, and southwest, which were collected here and transferred to the central office, *via* New York. From July 29, 1872, until September 1, full reports from all stations were received at midnight, New York sending all not obtained from other sources, and the map was printed during the night, containing, in addition to the reports in full, the afternoon probabilities of the previous day. This map was ready for issue at daylight, and was distributed freely throughout the principal business portions of the city. Since September 1, full reports are received three times each day, but the morning ones come in so late that the publication of the midnight map is continued. As soon as the change to the morning issue can be made without prejudice to the public interests it will be done.

The station was inspected in August, and office and instruments found in good condition. The inspector reports that the observer in charge, Sergeant Theodore Mosher, is "an intelligent man, and a zealous and experienced observer." He took charge of the station July 17, 1872, relieving Sergeant Mackintosh, transferred to Cleveland on that date. At present there are three assistants on duty there, the nature and amount of work done requiring that number. The reports are received at four different telegraph-offices, widely separated from each other, and their collection from these offices is a work of much difficulty, and at night not wholly free from personal risk. Arrangements are in progress for the consolidation of the several telegraph-offices, so far as United States business is concerned, and it is hoped they will prove successful.

Twenty-nine cautionary signals were displayed at this station from October 29, 1871, to September 1, 1872, twenty of which are reported as fully justified. As to known benefits or injury to commercial or other interests resulting from the display of signals, the observer at this point reports as follows:

November 13, 1871.—Several ships staid in harbor and escaped the gale.

November 18, 1871.—Many vessels staid in harbor; even persons delayed visits to distant points.

November 28, 1871.—A large number of vessels remained in port. The signal was justified by the heavy sea and the cold.

April 11, 1872.—A severe storm which wrecked several vessels Chicago-bound; vessels in this port did not put out.

April 29, 1872.—A number of vessels delayed their departure.

September 23, 1872.—This storm is said to have been one of the most severe ever experienced on Lake Michigan. The schooner Francis Bleniman, grain-loaded for the lower lakes, endeavored, while the signal was flying, to clear the harbor, but struck bottom, became unmanageable, and grounded hard on the bar. A tug was sent to her assistance, and had a sailor washed overboard and drowned.

September 30, 1872.—Several vessels delayed their departure on account of the warning given.

The inspecting officer reports that much public interest is manifested in the service, and that the members of the meteorological committee have rendered valuable assistance in various ways, both before and since the fire. A desire is expressed by the president of the Board of Trade to have the office rendered more easily accessible to the general visitor than at present, and substantial assistance to accomplish this is promised at an early date.

Meteorological summary.

Year.	Month.	Mean bar-ometer.	Mean ther-mometer.	Total rain-fall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October	(*)	-----		
	November	30.099	35	3.62	Northwest.
	December	30.099	20	3.44	West-southwest.
1872..	January	30.108	23.2	.68	Southwest.
	February	30.051	25.3	.84	Northeast.
	March	30.107	28.3	3.78	Northwest.
	April	29.983	47.9	3.03	Southwest.
	May	29.978	56.1	2.76	North.
	June	29.951	69.5	3.45	Southwest.
	July	29.969	72.8	3.09	Southwest.
	August	30.030	72.0	2.59	Southwest.
	September	29.912	64.0	6.43	Southwest.
	Mean for 11 months.	30.026	46.7	33.71	Southwest.

* Office destroyed by fire. No records.

CINCINNATI, OHIO.

[Latitude, 39° 06' ; longitude, 84° 30'.]

No change has been made in the location of this office during the year, nor is any change considered desirable at present. The station is supplied with a large standard wind-vane and with the telescopic rod and standard self-registering attachment for the anemometer, in addition to instruments on hand at last report. A morning edition of the weather-map was printed and issued regularly until June 30, 1872, when the issue was suspended on account of the failure to receive a sufficient number of reports. From that date until August 21, river reports were received from sixteen stations, each afternoon, and published regularly. Since August 21, twenty reports have been received three times each day. During the exposition, which opened September 3, 1872, a full midnight report was received from all stations, and a map issued in time for early distribution each morning. In addition to the detailed reports, the map contained the midnight probabilities, which were sent direct from the central office. Reports from the South are transferred at this station to Chicago and Washington.

Six thousand three hundred and fifty-six bulletins and five thousand eight hundred and ninety-eight maps have been issued, and two thousand and sixty-seven reports furnished the press. The newspapers at this station have taken a lively interest in the service, and have devoted a generous amount of space to the publication of reports. While full reports were received, the Commercial gave each morning a full table containing the reports of the afternoon and midnight previous. It also gave the river reports and probabilities regularly. The Gazette gave the full midnight report, river report, and probabilities; and the Times and Chronicle, the morning report and morning probabilities. Since the interruption of reports in June, these papers have issued the river reports and probabilities and the monthly statements prepared by the observer.

The station was inspected twice during the year, and the office and instruments found in good condition. During the last inspection reports were made by the president of the Board of Trade and the chairman

of the meteorological committee affecting the character of the observer, which led to his immediate relief and ultimate discharge from the service.

Sergeant F. B. Lloyd was in charge until relieved April 3, 1872, when his assistant, Private E. F. Maynard, was promoted to the grade of sergeant, and placed in charge. Sergeant Maynard has conducted the station in a satisfactory manner, rendering all reports promptly, and discharging his duties with marked intelligence and zeal. Two assistants have been kept permanently at the station, and during the month of September an additional one was supplied, in view of the increased amount of work required to supply the necessary number of maps and bulletins. All of them are reported as having performed their duties satisfactorily.

The river reports are regularly made, the observations being made from the standard gauge erected by the city at the water-works.

Mr. Davis, the chairman of the meteorological committee of the Chamber of Commerce, is deeply interested in the service; and gives his personal attention to the station, with the view of rendering such assistance as may be necessary from time to time.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.152	60	1.80	East-southeast.
	November.....	30.135	48	4.18	Southeast.
	December.....	30.208	33	3.27	South-southwest.
1872..	January.....	30.218	31	.60	South-southeast.
	February.....	30.082	36	1.67	East-northeast.
	March.....	30.149	37.6	1.47	South.
	April.....	30.080	57.8	5.14	Southeast.
	May.....	30.048	67	4.70	West.
	June.....	30.042	75	3.81	Southwest.
	July.....	30.025	80.1	7.01	Southwest.
	August.....	30.092	78.6	2.21	South.
	September.....	30.072	66.1	1.62	South.
	Annual mean....	30.109	55.9	37.48	Southeast.

The observer at this station has taken unusual pains in the preparation of his monthly statements for publication, and has thereby made them of special value for future reference.

CLEVELAND, OHIO.

[Latitude, 41° 30'; longitude, 81° 36'.]

No change has been made in the location of the office at this station, nor has it been inspected since the date of last report. The condition of the instruments and office is reported good by the observer. The station is supplied with a large standard wind-vane, and with the telescopic rod and standard self-registering attachment to the anemometer.

Full reports from all stations were received and published until June 30, 1872. From that date until September 1, none were received. Since September 1, fifty-two reports were received, but not with sufficient regularity to make them of value. It is hoped, however, that the

telegraphic facilities will be increased in a short time, so as to insure satisfactory work at this station.

During the year, four thousand six hundred and seventy-one bulletins and one thousand five hundred and sixty-five maps have been issued, and three thousand and eighty-three reports furnished the press. But little use was made of the press reports, as the papers only published them at rare intervals. All the principal dailies, however, publish the probabilities when received.

Sergeant Theodore Mosher was in charge of station until transferred to Chicago, July 17, 1872. He was succeeded by Sergeant James Mackintosh. Both men have given entire satisfaction, and have rendered their reports promptly and neatly. Private Craig, the assistant at date of last report, was relieved for misconduct, February 12, 1872, and succeeded by Private E. Moran, who still remains.

Twenty-seven cautionary signals were displayed between October 23, 1871, and September 1, 1872. Upon the result of the several displays, the observer reports as follows:

October 30, 1871.—Steamer Benton, Captain McGregor, and several sailing-vessels remained in port on account of the signal flying.

November 1, 1871.—Steamer Meteor, Captain Wilson, remained in port until 9 a. m., when she went out while the signal was still up, but had to return. A number of sailing-vessels also remained in on account of the warning.

November 16, 1871.—Schooner H. C. Williams, Captain Fuller, saw signal being hoisted, but left port. She was obliged to put back about 7 p. m., and in endeavoring to enter the harbor, struck against the pier and went down, one of the crew being drowned. A number of steamers, schooners, &c., staid in on account of the warning given.

November 19, 1871.—Two schooners and one brig remained in port on account of signal flying.

December 4, 1871.—Severe storm; no damage reported.

December 6, 1871.—Very heavy wind, blowing in heavy gusts.

April 4, 1872.—The schooners Wanderer and Traveler, which were just leaving port, returned and staid in on account of the warning, and thus escaped the gale.

The observer reports that he is frequently called upon by sailors and others for information, and that many of them bring aneroid barometers to his office for adjustment and comparison.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October	30.04	55.0	.60	Southeast.
	November	30.03	37.0	2.42	Northwest.
	December	30.00	26.3	.84	Southwest.
1872..	January	30.06	25.0	2.00	Southwest.
	February	30.02	25.0	.80	Northwest.
	March	30.074	28.3	1.30	Northwest.
	April	30.018	49.3	2.22	Southeast.
	May	29.966	58.4	3.99	Southeast.
	June	29.953	69.0	2.68	Southwest.
	July	29.968	73.9	6.19	Northwest.
	August	30.029	73.7	4.53	Northwest.
	September	29.984	64.9	3.47	Southeast.
	Annual mean	30.012	48.8	31.04	Southerly.

The winds considered dangerous at this station, by sailors, are those from the northeast, north, and northwest, especially the latter, with a

velocity of twenty miles and upward per hour. Southeasterly winds are not considered dangerous, unless accompanied by snow and fog.

CORINNE, UTAH.

[Latitude, $41^{\circ} 30'$; longitude, $112^{\circ} 18'$.]

No change has been made in the location of the office at this station. Reports from ten stations have been received here, except during the period from June 30 to September 1, 1872, when the only ones received were those from Fort Benton and Virginia City, which are regularly transferred here to Chicago.

Six hundred and twenty-three bulletins have been issued during the year, and two hundred and thirty-one reports furnished the local paper. A large wind-vane has been erected on a substantial platform since last report; but other than this, the instruments remain the same, and are reported in good condition.

Sergeant William McElroy was in charge of station until July 17, 1872, when he was transferred to Buffalo, and was succeeded by Sergeant S. W. Beall. All reports have been forwarded promptly and in proper form, and the duties of the station performed satisfactorily.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	29.936	44.0	.35	North.
	November.....	29.859	34.4	3.22	Northeast.
	December.....	29.944	30.4	4.04	Southwest.
1872..	January.....	30.183	26.6	.70	North.
	February.....	30.031	34.5	2.42	North-northeast.
	March.....	30.033	40.5	.55	Northwest.
	April.....	29.945	45.6	1.43	North.
	May.....	29.985	58.4	2.66	Northwest.
	June.....	29.993	69.0	.47	South.
	July.....	30.012	75.0	.11	North.
	August.....	30.039	72.3	1.04	North-northwest.
	September.....	30.073	59.9	.14	North.
	Annual mean....	30.003	49.2	17.13	North.

DAVENPORT, IOWA.

[Latitude, $41^{\circ} 30'$; longitude, $90^{\circ} 36'$.]

The location of the office has not been changed during the year, nor is a change considered desirable, as it is in the business center of the city. Reports from twenty-five stations were received daily until July 1, 1872. From that date nothing was received except the river reports from sixteen stations each afternoon, until August 21, when a circuit was arranged from Chicago to Saint Louis, passing through this station, by which means it was to be supplied regularly with twenty-five reports. Up to the present date the telegraphic service at the station has been very unreliable, but there is a reasonable prospect of speedy improvement in this respect.

During the year two thousand six hundred and five bulletins have been issued, and six hundred and seventy-five reports furnished the press. The leading papers publish the river reports, the probabilities, and the monthly statements regularly, and the tabular reports occasionally. No maps have been issued.

The station has been twice inspected since the date of last annual report, once in December, 1871, and again in August, 1872. At the first inspection the office, instruments, and records were found in excellent condition. At the second one numerous irregularities were discovered and corrected.

Sergeant George H. Richmond was in charge of station until relieved on account of ill-health, February 3, 1872. He was succeeded by Sergeant D. S. Pullen, who remained until relieved for misconduct, June 8, 1872, and since that date Sergeant Max Marix has been in charge. Reports are now forwarded promptly and neatly. In reference to the character of the observer, the inspecting officer remarks:

The sergeant in charge of this station is an industrious and steady man, and is well spoken of by the secretary of the Board of Trade. He has had much to contend with on account of the bad name the office had obtained from his immediate predecessor, and also much back work to do chargeable to the same account.

Private E. Lloyd was the assistant until called in for promotion, February 10, 1872. Two other men were sent and relieved in rapid succession, on account of ill-health. The present assistant, Private W. D. Wright, has been on duty since June 1, and gives satisfaction.

River reports are made from this station, the gauge used being one constructed by the United States Engineer Corps. The anemometer is provided with the standard self-registering attachment. All instruments are reported to be in good condition. A large wind-vane has been erected since last report, which indicates the direction of the wind upon the ceiling of the office-room, in the authorized manner.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean ther- mometer.	Total rain- fall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October	30.050	54.4	3.19	Southwest.
	November	30.132	33.6	3.33	East-northeast.
	December	30.173	20.5	1.61	West-southwest.
1872..	January	30.176	23.0	.13	West-southwest.
	February	30.070	27.8	.10	Northeast.
	March	30.120	33.3	1.82	Northwest.
	April	29.967	50.9	5.06	Southwest.
	May	29.978	61.5	4.46	Northwest.
	June	29.966	73.2	3.78	Southwest.
	July	29.982	76.3	3.80	Northwest.
	August	30.051	74.6	8.91	Southwest.
	September	29.978	64.6	5.30	Southwest.
	Annual mean	30.054	49.5	41.49	Southwest.

DENVER, COLORADO.

The office is located on G street, near Larimer, in the business part of the city, but, as the rent is high, the observer has been ordered to remove as soon as a more suitable location can be obtained. The wind-vane, (small pattern,) anemometer, and rain-gauge are well-exposed on the roof of building, and the shelter is of the authorized form. The station has not been visited by an inspecting officer. It was established by Sergeant Henry Fenton, and reports commenced November 20, 1871, and have been sent regularly since that date, with the exception of the midnight and morning reports since July 1, 1872, delayed on account of telegraph office being closed.

The station is supplied with one barometer, (Green's standard,) one thermometer, one hygrometer, one Robinson anemometer, one wind-vane, one rain-gauge, one maximum and one minimum thermometer, all in good condition, except the last-named, which is broken.

During the year one thousand and twenty-six bulletins have been issued, and one hundred and thirty-five reports furnished the press.

Latitude of station 39° 44'
Longitude 104° 58'
Elevation of barometer above sea-level 5,267 feet.

There is no assistant at the station, and no reports are received from other stations.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean ther- mometer.	Total rain- fall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....				
	November.....	29.706	23.4		South.
	December.....	29.788	29.2		South.
1872..	January.....	30.027	23.8	.55	South.
	February.....	29.891	33.7	.22	South.
	March.....	29.959	36.2	1.71	South.
	April.....	29.839	46.1	2.09	North.
	May.....	30.009	57.7	3.74	North.
	June.....	30.049	67.2	2.07	South.
	July.....	30.101	69.3	2.69	South.
	August.....	30.124	69.8	1.65	South.
	September.....	30.066	60.1	1.57	South.
	Mean for 11 months.	29.964	47.0	16.29*	South..

* Amount for nine months.

DETROIT, MICHIGAN.

[Latitude, 42° 18'; longitude, 83° 00'.]

No change has been made in the location of the office at this station, nor is any considered necessary at present. Full reports were received until June 30, 1872, and published in the usual manner. From that date until September 1 the only reports received were those from Grand Haven. Since September 1 fifty-two reports have been received three

times each day when the telegraph-line over which they are transmitted is in good order. Some irregularities in this respect have occurred which, it is hoped, time will correct.

During the year seven thousand two hundred and three bulletins and three thousand two hundred and six maps have been issued, and one thousand three hundred and sixty-eight reports furnished the press. The leading daily papers publish the tabular reports, probabilities, and monthly statements regularly, and manifest a gratifying interest in the development of the service.

The station is provided with a large wind-vane and with the telescopic rod and the standard self-registering attachment to the anemometer. The station has not been regularly inspected during the year, but was visited by an officer and found in excellent condition, with the records neatly kept and up to date, and instruments well exposed and cared for.

Twenty-five cautionary signals have been displayed here since the date of the last annual report.

Sergeant Allen Buell was relieved October 16, 1871, by Sergeant F. Mann, who still remains in charge, and has given full satisfaction, by the manner in which his duties have been performed. Private McGovern was relieved as assistant April 15, 1872, by Private Stromberger. The report of the number of maps and bulletins issued gives evidence of the amount of work done and of the energy of the observer.

Reports from Grand Haven and Alpena are transferred here to the New York circuit.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	29.997	55	.69	Southwest.
	November.....	30.040	33	2.76	Northwest.
	December.....	29.990	23	1.88	West.
1872..	January.....	30.040	23	1.05	Southwest.
	February.....	30.020	23	.69	Northwest.
	March.....	30.054	25.6	1.22	West.
	April.....	29.976	46.8	2.15	East.
	May.....	29.936	56.8	5.64	West.
	June.....	29.923	68.3	2.85	Southwest.
	July.....	29.920	72.8	2.63	Southwest.
	August.....	29.990	71.6	2.60	Southwest.
	September.....	29.944	62.6	3.84	Southwest.
	Annual mean.....	29.986	46.8	28.00	Southwest.

DU LUTH, MINNESOTA.

[Latitude, 46° 48'; longitude, 92° 06'.]

The office remains, as at last report, in Edmund's Block. The only reports received are those from Saint Paul. Eight hundred and fifteen bulletins have been issued and seven hundred and fifty-five reports furnished the press.

The station is supplied with a large standard wind-vane and with the

telescopic rod and the standard self-registering attachment to the anemometer. The necessary apparatus for displaying cautionary signals was furnished the station in May, 1872, but up to this date only two signals have been ordered.

Sergeant A. B. Williams was in charge of station until June 1, 1872, when he was relieved by Sergeant John Dascomb.

From July 1 to September 16, 1872, morning and midnight reports were sent very irregularly, as the telegraph-office was seldom open at the hours for reporting. Since September 16, arrangements have been made by which this difficulty is removed, and these important reports will be received hereafter with greater regularity, it is hoped.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October	29.990	45.0	4.19	Northwest.
	November	30.113	28.0	1.47	Northwest.
	December	30.069	7.7	2.05	Southwest.
1872..	January	30.061	13.4	.86	Southwest.
	February	29.989	18.2	.46	Northeast.
	March	30.117	18.7	.85	Northwest.
	April	29.916	37.0	1.80	Northeast.
	May	29.947	46.4	4.62	Northwest.
	June	29.858	59.6	4.46	North-northeast.
	July	29.891	66.8	5.83	North-northeast.
	August	29.932	68.1	2.84	North-northeast.
	September	29.849	55.7	5.01	North-northwest.
	Annual mean	29.978	38.7	34.44	Northeasterly.

The observer, in his semi-annual report of January 1, 1872, says:

Toward the last four months before the close of navigation, very few captains left the harbor without calling at this office for information. They all have perfect confidence in our weather reports and consider them a great benefit to lake navigation.

ESCANABA, MICHIGAN.

[Latitude, 46° 36'; longitude, 87° 06'.]

No change has been made in the location of the office at this station since last report, nor is any considered desirable. Up to January 1, 1872, reports from ten stations were sent to this station, but, owing to the irregularity with which they were received, their transmission was discontinued on the date named. Three hundred and one bulletins have been issued during the year. No cautionary signals have been displayed, nor press report published, except the monthly statements occasionally. The station is supplied with a large standard wind-vane and the telescopic rod and the standard self-registering anemometer attachment. All the instruments are reported in good condition.

From July 1 until September 16, 1872, the morning and midnight reports were delayed on account of the telegraph-office being closed at the hours of report, but since that date this difficulty has been removed.

Sergeant J. N. Martin was in charge of the station until September 4,

1872, when he was relieved by Sergeant Robert J. Bell. Sergeant Martin performed his duties in a manner satisfactory to his superiors, and was relieved at his own request.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October	29.93	47.0	2.94	South.
	November	30.09	32.0	1.94	Northwest.
	December	30.04	11.3	1.41	West.
1872..	January	30.02	17.0	.90	West.
	February	30.00	20.0	1.19	South.
	March	30.077	16.2	1.24	West.
	April	29.937	36.5	1.50	South.
	May	29.921	49.8	7.21	Northeast.
	June	29.864	63.0	2.45	South.
	July	29.918	67.0	7.11	South.
	August	29.977	66.7	2.87	South.
	September	29.868	57.5	3.97	North.
	Annual mean....	29.970	40.3	34.73	South.

FORT BENTON, MONTANA TERRITORY.

This station was established by Sergeant William F. Slater, and reports were first made November 25, 1871. Owing to the uncertainty of telegraphic communication with a location so far removed from the settled portion of the country, there has been much irregularity in the transmission of reports, especially since July 1, 1872, as the telegraph-office has been closed at the hours for sending the morning and midnight reports, and they have been sent at such times as the operator found it convenient to be at his post. This difficulty has rendered the position of the observer an uncomfortable one, by cutting him off from regular correspondence with his associates, which was possible so long as he was free to file his reports at the same hours with his widely-scattered comrades. The office was first located outside of the fort, but that position being unsafe, the observer moved within the fort, and still remains there. All mail-reports have been forwarded regularly and in proper shape, and the attention to duty of the observer has been unremitting. No reports were received here and no bulletins issued or published, the station being one of observation and report only.

It is provided with a complete set of standard instruments, the wind-vane used being of the small model. All instruments are reported in good order. The station has not been inspected since its establishment, but an officer is now on his way to visit it.

Latitude of station	47° 52'
Longitude of station	110° 40'
Elevation of barometer above sea-level	2,674 feet.

No description of office has been furnished. The thanks of the office are due to the commanding officer and to the post quartermaster for valuable assistance in fitting up the station.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	December	30.22	7.6	1.30	Southwest.
1872..	January	30.09	18.5	.27	Southwest.
	February	29.83	26.0	.34	Southwest.
	March	29.99	36.7	.82	Southwest.
	April	29.92	43.6	.67	Southwest.
	May	29.98	55.1	.64	Southwest.
	June	29.96	63.7	1.14	Southwest.
	July	30.024	61.4	4.62	Southwest.
	August	30.013	65.5	.61	Southwest.
	September	29.923	55.1	1.82	Southwest.
	Mean for ten mont's.	29.995	43.3	12.23	Southwest.

FORT SULLY, DAKOTA TERRITORY.

The office at this station is in the same room as the telegraph-office, and within the walls of the fort. The shelter is a modification of the standard form, and the best that could be constructed under the circumstances. The anemometer and wind-vane (small pattern) are well exposed on a strong platform on the roof of the office-building, and are reached by means of a rude stairway or ladder from one window of the room. The rain-gauge is well exposed on the parade-ground. The station is supplied with one barometer, one thermometer, one hygrometer, one maximum and one minimum thermometer, in addition to the instruments mentioned above, and all are reported in good condition.

The station was established by Sergeant George Prender, who still remains in charge, and who has performed his duties in a satisfactory manner. Reports commenced May 1, 1872, and have been sent as regularly since that time as telegraphic facilities would permit. Owing to the isolated and unprotected condition of the line from Yankton to the Fort—a distance of two hundred and thirty miles—frequent accidents occur to interrupt communication, which render the transmission of the reports unreliable. From July 1 to September 16, 1872, the telegraph-office was closed at the hours for sending the morning and midnight reports, which of course increased the difficulty of getting them off. Since the latter date arrangements have been made to keep the office open; but little improvement has yet been made in the work of getting the reports to Omaha, where they are transferred eastward.

Latitude of station..... 44° 39'
Longitude of station 100° 40'
Elevation of barometer above sea-level..... 1,491 feet.

No bulletins have been issued at this station, as no reports from other stations have been received.

General D. S. Stanley, United States Army, whose headquarters are at this fort, has rendered valuable assistance to the office, in providing shelter for the observer, and has manifested his constant interest in the service.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1872..	May	29.749	58.3	2.98	Northwest.
	June	29.646	70.3	2.34	Southeast.
	July	29.702	73.5	6.48	Southeast.
	August	29.734	72.2	1.53	Southeast.
	September	29.714	62.4	.21	Northwest.
	Mean for five months.	29.709	67.3	13.54	Southeast.

GALVESTON, TEXAS.

[Latitude, 29° 19' ; longitude, 94° 46'.]

No change has been made in the location of the office since last report. Reports from eighteen stations were received here, until July 1, 1872, when the telegraph company discontinued their transmission, and has not yet resumed. The reports from the station have been forwarded as regularly as the telegraphic facilities would permit. Since July 1, the morning and midnight reports have been delayed by the closing of the telegraph-office at the proper hours for their transmission.

During the year, two thousand seven hundred and seventeen bulletins have been issued and four hundred and forty reports furnished the press. The leading papers have published the tabular reports, the probabilities, when received, and the regular monthly statements furnished by the observer. The station has been twice inspected during the year, once in October, 1871, and again in July, 1872. At the time of the first inspection, the instruments were found badly placed and the shelter for them poorly constructed. These errors were corrected at once, and at the time of the second inspection office and instruments were found in good order, and the latter well exposed and cared for. The anemometer is provided with the standard self-registering attachment, and the direction of the wind is indicated by a large wind-vane of the standard pattern.

Sergeant William Von Hake, who was in charge of the station at the date of last report, was relieved on account of ill-health, October 2, 1871, and was succeeded by Sergeant George S. Rowley, who was in turn relieved and transferred to another station, February 27, 1872. Private McInerney, the assistant at the station, was promoted to the grade of sergeant, and placed in charge on the date last named, and still remains, having given full satisfaction by his management of the station and prompt rendition of all reports. He worked the station alone for some weeks, when the labor became too arduous for one man, and an assistant was sent from the central office.

Sergeant Von Hake died within a few hours after his return to Washington, and was buried in the National Cemetery, on Arlington Heights, with appropriate military honors. He was a hard-working, intelligent man, and performed his duty zealously and well.

The station is prepared for the display of cautionary signals, but none have yet been ordered, owing to the want of a sufficient number of re-

ports from points in the northern and western parts of Texas to afford a reasonable basis of observation.

The members of the meteorological committee have shown a marked interest in the station during the year and have frequently pointed out the necessity for a greater number of stations in the State.

The station has been furnished with an enlarged rain-gauge, to provide for the heavy rains which prevail at certain seasons of the year.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October	30.059	72.0	17.81	East.
	November	30.074	60.0	5.67	North.
	December	30.200	56.0	2.40	North.
1872..	January	30.230	50.0	4.61	North.
	February	30.002	55.0	2.27	Southeast.
	March	30.082	61.4	2.77	Southeast.
	April	30.002	71.7	5.96	Southeast.
	May	30.023	78.1	2.21	Southeast.
	June	30.033	83.0	3.39	South.
	July	30.039	85.6	.34	South.
	August	30.043	84.9	2.63	Southeast.
	September	30.024	82.1	2.33	Southeast.
	Annual mean	30.068	70.0	52.39	Southeast.

GRAND HAVEN, MICHIGAN.

[Latitude, 43° 05'; longitude, 86° 13'.]

The office was removed August 17, 1872, to the Cutler House, at the corner of Washington and Fourth streets, to get a better exposure of the instruments than could be obtained on the building first selected. The present exposure of the wind-vane, anemometer, and rain-gauge is reported by the inspecting officer as excellent. The instrument-shelter was reported defective in size and position, and a change has been ordered so as to make it conform to the standard. The new shelter will have a double wall of lattice-work, with a clear space of ten inches between the walls. The station is provided with a large wind-vane and with the standard telescopic rod and self-registering anemometer attachments.

During the year, two thousand six hundred and fourteen bulletins have been issued and three hundred and five reports furnished the press, but very few of which have been published. Since July 1, 1872, no reports have been received at this station, and the transmission of the midnight reports from the station has been delayed on account of the telegraph-office being closed at that hour. All other reports have been sent with a fair degree of regularity, except on Sundays, when the telegraph-office is usually closed. The station has been in charge of Sergeant Frank F. Wood since its establishment. It was inspected in September, 1871, and several irregularities in the manner of keeping the records discovered and corrected, but the main part of the work is reported to have been satisfactorily performed.

Twenty-five cautionary signals have been displayed during the year. The winds considered dangerous to navigation at this station are reported to be those from the southwest.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October	29.995	52.4	1.75	Southwest.
	November	30.074	33.2	2.33	East.
	December	30.020	22.7	1.38	West.
1872..	January	30.012	24.4	1.54	West.
	February	29.981	21.6	.64	West.
	March	30.035	24.3	1.64	West.
	April	29.933	43.6	2.31	Southwest.
	May	29.921	52.9	2.94	West.
	June	29.900	64.6	2.27	West.
	July	29.911	69.5	1.46	South.
	August	29.972	69.5	6.31	Southwest.
	September	29.890	60.8	9.37	West.
	Annual mean	29.970	45.0	33.94	West.

INDIANAPOLIS, INDIANA.

[Latitude, 39° 42' ; longitude, 86° 06'.]

No change has been made in the location of the office at this station since the date of the last annual report. Reports from thirty stations were received and published here until the suspension of the circuit system, June 30. Since the resumption of the system, on August 21, 1872, twenty-five reports have been regularly received, but during the interval between these dates the station-work was limited to the transmission and record of the local reports alone.

Six thousand and ninety-three bulletins have been issued during the year and three thousand and twelve reports furnished the press. The leading newspapers publish either the whole or a synopsis of the tabular reports, as they have space, the local reports in full, and the probabilities and monthly statements regularly. Maps have not been issued. The station is provided with a large standard wind-vane and with the standard self-registering anemometer attachment.

It has been twice inspected during the year, once in December, 1871, and again in September, 1872, and the office and instruments found in good condition on both occasions. Sergeant C. F. R. Wappenhans remains in charge, and has given full satisfaction by the regularity and promptness with which he has rendered all reports. Both inspecting officers commend his attention to duty. The assistant, Private D. C. Murphy, is also favorably mentioned.

In reference to the interest manifested in the service at this station, the observer reports as follows, in his monthly journal abstracts :

January 2, 1872.—A practical use of the tabulated report is also made by the agent of the Western Union Railroad and Transportation Company, and by other freight agents in settling claims of damage to merchandise by rain, &c., during its transit over their railroads.

July 2, 1872.—Several physicians have carefully noted daily, morning and evening,

the readings of the barometer, and one assured me that he altered his prescriptions accordingly, as he believes that changes in atmospheric pressure have a corresponding effect on the state of health of his patients.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.053	58.0	1.54	South.
	November.....	30.065	39.0	3.52	Northwest.
	December.....	30.111	28.0	2.39	Southwest.
1872..	January.....	30.130	26.0	1.17	Southwest.
	February.....	30.008	30.0	1.41	Northeast.
	March.....	30.043	35.0	1.31	Northwest.
	April.....	29.960	55.0	3.26	Southeast.
	May.....	29.988	64.0	3.22	West.
	June.....	29.976	74.0	3.28	Southwest.
	July.....	29.964	78.0	10.95	Southwest.
	August.....	30.032	76.0	2.69	Southwest.
	September.....	29.997	67.0	7.81	South.
	Annual mean....	30.027	52.5	37.55	Southwest.

INDIANOLA, TEXAS.

The office is located in Schultz's Building, on Main street, the principal business street of the town, within convenient distance of the post and telegraph offices. The roof of the building commands the entire bay and roadstead and the greater part of the town; and the wind-vane (small pattern,) anemometer, and rain-gauge, being firmly placed upon an elevated platform on the roof, have an excellent exposure. The shelter is of the standard pattern, and projects from a window having a northeastern exposure.

The station was established by Sergeant Edward Lloyd, and began reporting May 1, 1872. From that date until June 30, 1872, the reports were forwarded with regularity by the telegraph company, but since June 30 the telegraph-office has been closed at the times for sending the morning and midnight reports, and they have been seriously delayed in consequence. Frequent accidents to the line have also caused the loss of afternoon reports since the same date.

The station was inspected in July, and the office and instruments found in good condition. The inspector reports that the observer was highly spoken of by the members of the meteorological committee for his fidelity and close attention to duty. No reports from other stations are received here, and the only bulletins issued are those of the local observations. These have been supplied to the "Bulletin," a weekly paper, and regularly published.

Latitude of station 28° 31'
Longitude of station 96° 28'
Elevation of barometer above sea-level..... 25 feet

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
1872..	May	30.038	77.1	<i>Inches.</i> 1.08	Southeast.
	June	30.023	83.0	.86	Southeast.
	July	30.037	84.8	1.49	Southeast.
	August	30.043	83.4	2.84	Southeast.
	September	30.032	81.5	.81	Southeast.
	Mean for five mo...	30.035	82.0	7.08	Southeast.

JACKSONVILLE, FLORIDA.

[Latitude, 30° 15'; longitude, 82° 00'.]

No change in the location of the station has been made during the year. Reports from ten Gulf and Coast stations were received here until July 1, 1872, and since which date from those on the Florida coast alone. Four thousand one hundred and nineteen bulletins have been issued and the press regularly supplied. A meteorological committee has been appointed by the Board of Trade, and its members are unanimous in expressing their desire that the station should receive more reports, especially from points along the coast. The office is much visited by people from the North, temporarily stopping in the city, and who are desirous of knowing the state of the weather at their homes.

The station was inspected in March, and the office and instruments found in good condition. Sergeant D. A. Daboll has remained in charge during the year and given full satisfaction. His conduct and close attention to duty have been commended by the inspecting officer and by the chairman of the meteorological committee. Private J. H. Marsh was on duty as assistant until August 9, when he was ordered in for promotion, and succeeded by Private Simons.

The station is provided with the large standard wind-vane and with the standard telescopic rod and self-registering attachments to the anemometer.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
1871..	October	30.131	73.5	<i>Inches.</i> 3.62	Northeast.
	November	30.091	65.4	3.63	Northeast.
	December	30.226	55.4	2.65	Northwest.
1872..	January	30.174	52.7	3.44	Northwest.
	February	29.993	53.9	2.70	Southwest.
	March	30.102	59.1	7.32	Northeast.
	April	30.113	73.5	2.39	Northeast.
	May	30.089	78.3	1.25	Southwest.
	June	30.072	81.0	6.97	Southwest.
	July	30.089	83.4	2.92	Southeast.
	August	30.062	81.4	6.41	Northeast.
	September	30.065	77.7	10.65	Northeast.
	Annual mean	30.101	69.6	53.95	Northeast.

KEOKUK, IOWA.

[Latitude, 40° 18'; longitude, 91° 30'.]

The location of the office remains unchanged since the date of last report. Reports from twenty-six stations were received here from that date until July 1 and since August 21, 1872. During the interval the only reports received were those from sixteen river stations each afternoon, which were sent from Chicago after concentration there.

Three thousand seven hundred and sixty-three bulletins were issued and seven hundred and twenty reports furnished the press. The newspapers publish the river reports and the local observations regularly, and also the probabilities when received. River reports have been made regularly, the gauge used being constructed in accordance with plans furnished from the central office. Owing to its improper location it was injured by floating bodies in the river, and is now out of repair, and a graduated scale on the pier of the railroad-bridge is used for the readings. The station has been twice inspected during the year, once in December, 1871, and again in August, 1872. At the first visit several irregularities were discovered in the location and care of instruments and books; but the office was neatly kept and the observer and his assistant attentive to duty. At the second visit of the inspector the office was found in good condition, but some change was made in the manner of caring for the instruments.

Sergeant A. C. Barclay was relieved from charge of the station for misconduct, November 27, 1871, and was succeeded by Sergeant C. R. Daw, who still remains. Private Warren was on duty as assistant until called in for promotion. His successor was relieved for misconduct, August 31, 1872. Private W. O. Bailey is now on duty as assistant.

In addition to the instruments reported on hand at last report, the station is supplied with the large standard wind-vane and with the standard self-registering attachment to the anemometer.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
1871..	October.....	29.997	57.3	<i>Inches</i> 5.22	South.
	November.....	30.039	30.5	2.89	Northwest.
	December.....	30.095	25.8	1.46	Northwest.
1872..	January.....	30.117	25.8	.07	West.
	February.....	29.964	30.4	.39	Southeast.
	March.....	30.035	35.0	2.88	Northwest.
	April.....	29.904	53.9	3.66	Southwest.
	May.....	29.906	64.5	3.70	West.
	June.....	29.883	75.2	5.81	South.
	July.....	29.892	78.6	6.77	Northwest.
	August.....	29.945	77.3	1.97	South.
	September.....	29.906	68.2	2.26	South.
	Annual mean....	29.972	51.9	37.08	Westerly.

KEY, WEST, FLORIDA.

[Latitude, $24^{\circ} 36'$; longitude, $81^{\circ} 48'$.]

The office at this station was removed, March 1st, to the Louvre House, on Front street, and is on the third floor. The cupola of the building is used for the instrument-shelter, and upon its roof the wind-vane, (large pattern,) anemometer, and rain-gauge are exposed. The present location is a good one, and well adapted for the display of cautionary signals, when it is considered advisable to send them to this station.

Three thousand nine hundred and fifty-nine bulletins have been issued during the year, and the local observations have been regularly published by the newspaper at the station. An inspecting officer visited the station in February, 1872, and reported office and instruments in good condition. It was upon his suggestion that the location of the office was changed, and the new one was fitted up under his personal supervision. The anemometer is provided with the standard self-registering attachment. The duties of the station were performed by a citizen from the death of Sergeant John R. Allen, October 12, 1871, until the arrival of his successor, Sergeant M. J. Shanefelter, in November. Of the conduct of Sergeant Shanefelter, the inspecting officer remarks:

The sergeant in charge of this station bears a most excellent character in the community, and from my own observation I perceive that he is both faithful and zealous in the performance of his duties.

Upon the suggestion of an inspector, an assistant was sent to the station March 7, 1872. He was relieved for misconduct May 28, 1872, and was succeeded by Private W. A. Chapman, who still remains. Much valuable assistance to the observer has been rendered by General R. B. Ayres, commanding, and Lieutenant C. W. Hobbes, quartermaster of the post at Key West.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October	29.990	81.0	3.25	East.
	November	30.010	76.0	1.90	Northeast.
	December	30.160	71.0	3.32	Northeast.
1872..	January	30.120	68.0	1.60	North.
	February	30.028	68.0	7.19	Northeast.
	March	30.070	73.0	1.04	East.
	April	30.056	79.0	.08	East.
	May	30.065	79.8	1.01	East.
	June	30.063	83.4	2.14	East.
	July	30.081	83.5	6.92	East.
	August	30.025	84.3	4.89	East.
	September	29.987	84.1	3.15	East.
	Annual mean....	30.054	77.6	36.49	East.

KNOXVILLE, TENNESSEE.

[Latitude, 35° 56'; longitude, 83° 58'.]

No change has been made either in the location of the office at this station or in the observer in charge. No reports have been received from other stations since July 1, 1872, previous to which date those from Lynchburgh were regularly received. No bulletins have been issued, but one thousand one hundred and forty-eight reports of local observations have been furnished to the local press and published regularly.

The station has been inspected twice during the year, once in November, 1871, and again in July, 1872, and on both occasions the office and instruments were found in good condition. The station is provided with the standard self-registering attachment to the anemometer. Sergeant John K. Payne, professor of mathematics at the East Tennessee University, remains in charge, and has rendered all his reports regularly and in excellent condition.

Upon the interest manifested by the public in reference to the weather reports, the observer says:

A very general interest has been and is manifested in the weather reports by almost all classes of citizens—*e. g.*, contractors in charge of unfinished buildings which are endangered by wind and rain; people contemplating trips to the country; men in charge of brick-yards, when the hack is without roof, (as it usually is;) jobbers sending goods to country merchants by wagons; farmers with some sort of exposed harvests; road-builders with loose earth dumped, and liable to be cut away by water unless protected by ditches; "committee of arrangement" on pic-nics; political meetings, camp-meetings, &c.; ladies who "think of paying calls to-morrow," &c. All these classes, and many more, have been "observed" to examine the probabilities, and derive benefit therefrom.

Meteorological summary.

Year.	Month.	Mean bar-ometer.	Mean ther-mometer.	Total rain-fall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.155	58.0	4.28	Northwest.
	November.....	30.100	46.5	2.61	Northwest.
	December.....	30.190	37.0	3.27	Southwest.
1872..	January.....	30.183	32.2	2.99	Northwest.
	February.....	30.007	39.0	2.24	Northwest.
	March.....	30.080	43.5	3.04	Northwest.
	April.....	30.055	59.5	3.61	Northwest.
	May.....	30.029	68.0	2.86	West.
	June.....	30.020	73.0	6.68	Southwest.
	July.....	30.010	78.0	2.29	West-NW.
	August.....	30.050	76.2	6.27	Northeast.
	September.....	30.060	67.7	3.89	Northwest.
	Annual mean....	30.078	56.6	44.03	Northwest.

LAKE CITY, FLORIDA.

[Latitude, 30° 06'; longitude, 82° 42'.]

The location of the office has remained unchanged during the year. Until the 1st of July, the reports from ten other stations were received

and transferred to Key West and Jacksonville and northward. Since that date the only transfers made have been reports received from Key West, Punta Rassa, and Jacksonville. The failure of the telegraph company, by which communication is effected with Savannah, to keep its office open until the hour for sending the midnight report, has compelled the office to transmit the nine o'clock local observation, and has prevented any attempt to display cautionary signals on the coast of Florida. The telegraphic service of the lines running south and east from Lake City has been performed with regularity, and with as few interruptions as could be expected, considering the nature of the country through which the line passes.

No bulletins have been issued during the year. The principal value of this station consists in the fact of its being the point of transfer between the land and cable telegraph lines. The station is provided with the large wind-vane of the standard pattern, and also with the standard self-registering anemometer attachment. The station was inspected in March, 1872, and the office and instruments found in good condition.

Sergeant J. E. Magruder was in charge until April 15, when he was transferred to another station, and was succeeded by Sergeant George McDonald, who was relieved July 31, 1872, by Sergeant J. O'Dowd, who remains in charge. Private S. W. Beall was on duty as assistant until April 10, when he was ordered in for promotion, and was succeeded by Private Jones.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.644	71.0	5.03	Northeast.
	November.....	30.015	63.0	3.99	North.
	December.....	30.172	53.0	2.05	Northwest.
1871..	January.....	30.115	49.0	2.41	Northwest
	February.....	29.961	53.5	3.02	West.
	March.....	30.041	57.6	9.59	Southwest.
	April.....	30.056	71.6	1.90	East.
	May.....	30.045	78.1	.20	Southwest.
	June.....	30.027	79.3	5.29	Southwest.
	July.....	30.048	81.2	3.86	Southwest.
	August.....	30.019	79.4	5.25	Northeast.
	September.....	30.018	76.5	4.53	East.
	Annual mean.....	30.047	67.8	47.12	Southwest.

LEAVENWORTH, KANSAS.

[Latitude, 39° 21'; longitude, 94° 44'.]

No change has been made in the location of the office at this station since the date of last report. Reports from fourteen stations were received here until July 1, 1872, since which date the reports from the river stations alone have been received each afternoon. During the year four thousand five hundred and ninety-one bulletins have been issued, and one thousand four hundred and ninety-one reports furnished to the press. One paper only, the Commercial, publishes the tabular

reports, but all publish the monthly summaries. Previous to July 1, three papers gave the full tabular reports daily.

The station has been twice inspected during the year, once in November, 1871, and again in September, 1872, and on both occasions the office and instruments were found in good condition. The station is provided with a large standard wind-vane and the standard self-registering attachment to the anemometer. River reports have been sent from the station since January 1, 1872, and the observations are made from a gauge constructed in accordance with plans furnished from the central office. This gauge has been broken by drift-wood, and needs repairing.

Sergeant George Boehmer has been in charge of station since its establishment, and has performed his duties with marked intelligence and zeal. Owing to the increased amount of work required by the river observations, he was supplied with an assistant, Private W. S. Jewell, December 6, 1871, who remained until called in for promotion, May 17, 1872. The present assistant, Private E. W. McGann, has been compelled by the sickness of the observer to do all the station-work for some weeks, and has given satisfaction. All mail reports have been promptly and regularly furnished during the year, and some of them have been prepared with unusual care. Since July 1 the morning and midnight reports have been delayed by the failure of the telegraph company to have its office open at the proper hours for sending them.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.110	56.9	4.25	West.
	November.....	30.146	38.0	3.94	Northwest.
	December.....	30.250	24.2	0.73	Northwest.
1872..	January.....	30.240	25.0	0.13	Northwest.
	February.....	30.020	30.9	0.87	Northwest.
	March.....	30.093	36.0	1.95	Northwest.
	April.....	29.910	56.2	2.98	Southwest.
	May.....	29.943	65.6	7.91	Southwest.
	June.....	29.910	77.2	4.75	Southwest.
	July.....	29.972	78.4	9.92	Southeast.
	August.....	29.990	78.4	6.56	Southeast.
	September.....	29.937	67.7	4.22	Southwest.
	Annual mean....	30.043	53.0	48.21	Southwest.

LOUISVILLE, KENTUCKY.

[Latitude, 38° 00'; longitude, 85° 25'.]

The office was removed February 29, 1872, from the custom-house to the fourth story of the building at the corner of Main and Bullitt streets, in the business center of the city. The room commands a view of the whole city, and affords an excellent exposure for the anemometer, (which has the standard telescopic rod and self-registering attachments,) the wind-vane, (small pattern,) and the rain-gauge, all of which are firmly secured upon an elevated platform. The instrument shelter is of the standard pattern, with double louver boarded sides, and projects from a window with a northern exposure.

During the year six thousand and thirty-three bulletins have been issued, and nine hundred and eighty-six reports furnished the press. Reports from thirty stations were received here until July 1, from which time until August 21 the reports from all river stations were received each afternoon from Chicago as a special message. Since August 21, eighteen reports have been received daily. The leading dailies have published the full tabular reports regularly, and also the river reports, probabilities, and monthly statements, and have shown a gratifying interest in the development of the service. The river reports have also been published by the New Albany papers, being furnished them daily at the request of the editors. The standard city water-gauge, in the Louisville and Portland Canal, is used for the river observations.

The station was inspected in October, 1871, and August, 1872, and the office and instruments found in good condition. Sergeant Thomas J. Brown was in charge of station until transferred to the office of the Chief Signal Officer August 17, 1872, and rendered all reports promptly and in proper form. The wide distribution given to the reports here is due mainly to his personal energy and zeal. Sergeant Robert E. McGrady is at present in charge. The assistant on duty here at last report was relieved for misconduct December 15, 1871, and was succeeded by Private W. T. Boyd, who, being ordered in for promotion, was relieved by Private H. M. Ludwig June 17, 1872, who performs his duties satisfactorily.

The Board of Trade appointed a meteorological committee, the members of which have contributed assistance to the observer whenever necessary.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.106	60.5	1.85	Southeast.
	November.....	30.057	44.0	2.51	Northeast.
	December.....	30.145	38.0	3.29	Northwest.
1872..	January.....	30.161	30.8	(*)	Southwest.
	February.....	30.013	36.0	(*)	Northeast.
	March.....	30.087	38.7	1.41	Northwest.
	April.....	30.018	59.1	8.40	Southeast.
	May.....	30.009	67.6	4.49	Northwest.
	June.....	29.996	74.3	6.19	Northwest.
	July.....	29.979	79.0	3.67	Northwest.
	August.....	30.031	78.2	2.45	Northwest.
	September.....	30.009	69.8	4.41	South.
	Annual mean....	30.051	56.3	38.67	Northwest.

*Rain-gauge not in position.

LYNCHBURGH, VIRGINIA.

[Latitude, 37° 18'; longitude, 85° 54'.]

Sergeant James B. Murray has been in charge here since the establishment of the station, and has rendered his telegraphic reports with regularity. There is no assistant here, and none is considered necessary at present. Seven hundred and twenty-six bulletins of the local observations have been issued.

The office at this station remains in the building at the corner of Eighth and Court streets; and although somewhat removed from the business center of the town, is sufficiently near it for present purposes. No reports have been received here since July 1, 1872. Previous to that date about twenty reports were sent once daily through the courtesy of Mr. Joseph W. Kates, district superintendent of the Western Union Telegraph Company, and were displayed by him on bulletins furnished by this office. The station has been twice inspected during the year—once in October, 1871, and once in July, 1872. At the last inspection, the instrument-shelter was found defective, and a new one constructed of the standard pattern. The large wind-vane is used here, and also the standard self-registering attachment to the anemometer.

Meteorological summary.

Year.	Month.	Mean bar-ometer.	Mean ther-mometer.	Total rain-fall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.175	57.5	1.60	Southwest.
	November.....	30.080	47.1	3.76	Northwest.
	December.....	30.175	35.0	1.12	Southwest.
1872..	January.....	30.114	33.1	2.08	Southwest.
	February.....	30.037	36.2	1.99	Northeast.
	March.....	30.065	39.6	4.24	Southwest.
	April.....	30.079	57.5	3.20	Southwest.
	May.....	30.012	67.7	3.15	Southwest.
	June.....	30.006	74.1	2.53	Southwest.
	July.....	29.999	78.0	1.56	Southwest.
	August.....	30.050	77.1	2.27	Southwest.
	September.....	30.066	69.5	1.26	Southwest.
	Annual mean....	30.072	56.0	28.76	Southwest.

MARQUETTE, MICHIGAN.

[Latitude, 46° 33'; longitude, 87° 23'.]

No change has been made in the location of the office during the year. The reports from fourteen other stations were received here until January 1, when they were discontinued on account of the irregularity with which they were received. Much difficulty has been encountered in transmitting the reports from this station, owing to the unreliable nature of the telegraphic communication with Milwaukee, to which place its reports are sent.

From July 1 to September 16, another difficulty existed in the closing of the telegraph-office at the hours for sending the morning and midnight reports; but this is now removed, and it is hoped that communication will be more regular hereafter. The geographical position of this station renders its reports of special importance to the shipping interests on the lakes. In addition to the instruments on hand at last report, the station has been provided with a large standard wind-vane, and the standard telescopic rod and self-registering attachments to the anemometer.

Previous to the discontinuance of reports in January, one thousand two hundred and fifty-six bulletins were issued. Sergeant William H.

Clendenon, the observer in charge, has performed his duties satisfactorily, and has managed his station without an assistant. Arrangements have been made for the display of cautionary signals whenever necessary.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	29.890	47.0	2.97	Southwest.
	November.....	30.060	30.0	.65	Northwest.
	December.....	29.960	14.0	.33	West.
1872..	January.....	29.980	18.7	.39	West.
	February.....	*	18.7	.31	West.
	March.....	*	15.5	.37	West.
	April.....	*	37.3	.88	West.
	May.....	29.930	46.0	6.60	Northwest.
	June.....	29.850	59.4	3.32	West.
	July.....	29.890	59.6	4.79	West.
	August.....	29.930	65.4	2.74	Northwest.
	September.....	29.860	55.6	8.30	Northwest.
	Annual mean....	Blank.	38.9	31.65	West.

* Barometer broken.

MEMPHIS, TENNESSEE.

[Latitude, 35° 08'; longitude, 88° 00'.]

The office is on the third floor of building No. 204 Second street, in the business center of the city, and, in the opinion of the inspecting officers, could not be better located. The station has been twice inspected during the year—once in November, 1871, and once in August, 1872. Alterations in the instrument-shelter were found necessary on both occasions, but in most other respects the office and instruments were found in good condition. This station is on the same circuit as Louisville, and receives the same number of reports. From July 1 to August 21 the only reports received were those of the river stations each afternoon. Regular observations of the stage of water in the river have been made and reported since January 1, 1872, the gauge used being one constructed by the United States Engineer Corps. In the reference to the value of the river reports, the observer remarks:

At this port captains and pilots of boats going up the river generally decide by the river reports whether they can continue up the Mississippi or go up the Ohio, and, if so, how far. Boats arriving here from below at 12 o'clock midnight or later, examine the reports on the board at the levee, and if they have no business here, continue on up the river; otherwise, if it were not for the reports, they would have to wait for the morning papers to learn the stage of the water. Before the signal-service reports were published, from six to ten hours were lost at night by boats waiting for the morning papers, all of which is now obviated. The service is highly spoken of by rivermen as being of immense value to their interests.

Five thousand five hundred and sixty-nine bulletins have been issued, and one thousand five hundred and two reports furnished the press. The leading dailies print the probabilities and river reports regularly, and the monthly statements and selections from the tabular reports occasionally. Sergeant S. W. Rhode has been in charge during the year, and given satisfaction. Two assistants, serving at the station since last

report, have been promoted. One has been relieved for misconduct and one deserted. Private Nuzum, the present assistant, has been on duty but a short time, having reported September 9.

The inspecting officer gives the following illustration of the practical value of meteorological observations:

During my inspection a gentleman came into the office for information as to the weather on certain days last February, having a law-suit turning on that point. The observer was able to give him all the information needed.

The anemometer here is provided with the standard self-registering attachment, and the direction of the wind is indicated by a large standard vane.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.107	63	4.04	South.
	November.....	30.085	47	2.23	Northwest.
	December.....	30.228	39	1.62	South.
1872..	January.....	30.261	35	2.17	West.
	February.....	30.037	43	4.24	South.
	March.....	30.128	47	5.19	East.
	April.....	30.047	64	6.99	South.
	May.....	30.058	71	4.16	Southwest.
	June.....	30.055	76	4.44	Southwest.
	July.....	30.041	83	4.23	Southwest.
	August.....	30.087	81	.54	Northeast.
	September.....	30.071	73	3.62	South.
	Annual mean....	30.100	62.2	43.17	South.

MILWAUKEE, WISCONSIN.

[Latitude, 43° 03'; longitude, 87° 57'.]

The office remains in the same building occupied at the date of last report, and is well located with reference to the business interests of the city. It was inspected in September, and several irregularities discovered in the condition of the instruments and of the instrument-shelter, all of which were promptly corrected. Full reports were received here until July 1, 1872, when, in common with the other lake stations, it was deprived of them by the suspension of the circuit system. From that date until September 1, the only reports received were those from the northwestern stations, which were here transferred to New York. Since September 1 an attempt has been made to revive the circuit system, and furnish full reports again. Considerable difficulty was met with in effecting the necessary wire-connections at other points upon the circuit to enable the work to be properly done, and, as a consequence, the service has not been as regular as could be wished.

Three thousand one hundred and sixty bulletins and two thousand two hundred and fifty-one maps have been issued, and nine hundred and ninety-three reports furnished to the press. The leading papers publish the probabilities and monthly statements regularly, and occasionally extracts from the daily reports. In reference to the amount of public interest manifested in the service, the observer remarks as follows:

As a proof that our signal-service is advancing rapidly in favor among the people, I would state that those newspapers which a few months since would have nothing to do with the weather-reports, now publish daily, at least, the probabilities, and even

go so far as to attract the attention of their readers by a voluntary and favorable notice of the weather-items. This state of affairs has been largely promoted by the people, who, perceiving the benefits derived by them from the service, as applied to their every-day affairs, have insisted upon the publication of the weather-reports in their respective journals, and a great many have lately expressed their regret at the sudden stoppage of the weather-reports, and their criticisms upon the course of the telegraph company are extremely unfavorable to that corporation.

Twenty-nine cautionary signals were displayed at this port, of which twenty were considered as fully justified. As to the results of these warnings, the observer reports as follows :

November 9, 1871.—Only two vessels disregarded the signal and put out of the harbor, and were overtaken by the storm and were seriously damaged. The remainder of the shipping staid in port.

November 12, 1871.—No damage to vessels, as all remained in harbor.

November 20 and 23, 1871.—Vessels remained in harbor; no damage.

November 26 and 28, 1871.—Steamers were kept in port; no damage.

April 9, 1872.—Twenty-two vessels remained in port; no damage.

April 11, 1872.—Vessels staid in port; one vessel, Milwaukee bound, was capsized.

Sergeant A. Brimer was in charge of the station until September 6, when he was relieved by Sergeant D. H. Sackett. Sergeant Brimer is favorably mentioned in the report of the inspecting officer, but was relieved on account of ill-health.

Much trouble was experienced with the assistants at this station during the year, two having been relieved in quick succession for misconduct, and one for ill-health. Private T. O'Neill was ordered here for duty February 10, and remained until called in to be examined for promotion, September 13. He was succeeded by Private James Courtney.

The station is supplied with the large standard wind-vane, and the standard telescopic rod and self-registering attachments to the anemometer.

Considerable interest has been manifested in the welfare of the station by the members of the meteorological committee, who state that the suspension of the reports during the harvest season was severely felt by the farming community.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.030	51.5	3.37	Southwest.
	November.....	30.090	33.0	2.54	Northwest.
	December.....	30.040	17.2	1.55	Northwest.
1872..	January.....	30.000	21.0	.90	Northwest.
	February.....	30.000	23.0	.34	Northwest.
	March.....	30.060	24.5	.53	Northwest.
	April.....	29.930	40.0	1.84	Southeast.
	May.....	29.940	52.0	2.92	Southeast.
	June.....	29.920	67.0	3.67	Southwest.
	July.....	29.940	70.0	1.98	Southwest.
	August.....	30.000	71.0	1.89	Southwest.
	September.....	29.913	62.6	8.72	Southwest.
	Annual mean....	29.989	44.4	30.25	S. W. and N. W.

MOBILE, ALABAMA.

[Latitude, 30° 42'; longitude, 87° 59'.]

The office was removed to the third story of the building at the south-east corner of Government and Royal streets, May 1, 1872, and is now

the readings of the barometer, and one assured me that he altered his prescriptions accordingly, as he believes that changes in atmospheric pressure have a corresponding effect on the state of health of his patients.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.053	58.0	1.54	South.
	November.....	30.065	39.0	3.52	Northwest.
	December.....	30.111	28.0	2.39	Southwest.
1872..	January.....	30.130	26.0	1.17	Southwest.
	February.....	30.008	30.0	1.41	Northeast.
	March.....	30.043	35.0	1.31	Northwest.
	April.....	29.960	55.0	3.26	Southeast.
	May.....	29.988	64.0	3.22	West.
	June.....	29.976	74.0	3.28	Southwest.
	July.....	29.964	78.0	10.95	Southwest.
	August.....	30.032	76.0	2.69	Southwest.
	September.....	29.997	67.0	2.81	South.
	Annual mean....	30.027	52.5	37.55	Southwest.

INDIANOLA, TEXAS.

The office is located in Schultz's Building, on Main street, the principal business street of the town, within convenient distance of the post and telegraph offices. The roof of the building commands the entire bay and roadstead and the greater part of the town; and the wind-vane (small pattern,) anemometer, and rain-gauge, being firmly placed upon an elevated platform on the roof, have an excellent exposure. The shelter is of the standard pattern, and projects from a window having a northeastern exposure.

The station was established by Sergeant Edward Lloyd, and began reporting May 1, 1872. From that date until June 30, 1872, the reports were forwarded with regularity by the telegraph company, but since June 30 the telegraph-office has been closed at the times for sending the morning and midnight reports, and they have been seriously delayed in consequence. Frequent accidents to the line have also caused the loss of afternoon reports since the same date.

The station was inspected in July, and the office and instruments found in good condition. The inspector reports that the observer was highly spoken of by the members of the meteorological committee for his fidelity and close attention to duty. No reports from other stations are received here, and the only bulletins issued are those of the local observations. These have been supplied to the "Bulletin," a weekly paper, and regularly published.

Latitude of station 28° 31'
Longitude of station 96° 28'
Elevation of barometer above sea-level..... 25 feet

Meteorological summary.

Year.	Month.	Mean bar-ometer.	Mean ther-mometer.	Total rain-fall.	Prevailing wind.
1872..	May	30.038	77.1	<i>Inches.</i> 1.08	Southeast.
	June	30.023	83.0	.86	Southeast.
	July	30.037	84.8	1.49	Southeast.
	August	30.043	83.4	2.84	Southeast.
	September	30.032	81.5	.81	Southeast.
	Mean for five mo....	30.035	82.0	7.08	Southeast.

JACKSONVILLE, FLORIDA.

[Latitude, 30° 15'; longitude, 82° 00'.]

No change in the location of the station has been made during the year. Reports from ten Gulf and Coast stations were received here until July 1, 1872, and since which date from those on the Florida coast alone. Four thousand one hundred and nineteen bulletins have been issued and the press regularly supplied. A meteorological committee has been appointed by the Board of Trade, and its members are unanimous in expressing their desire that the station should receive more reports, especially from points along the coast. The office is much visited by people from the North, temporarily stopping in the city, and who are desirous of knowing the state of the weather at their homes.

The station was inspected in March, and the office and instruments found in good condition. Sergeant D. A. Daboll has remained in charge during the year and given full satisfaction. His conduct and close attention to duty have been commended by the inspecting officer and by the chairman of the meteorological committee. Private J. H. Marsh was on duty as assistant until August 9, when he was ordered in for promotion, and succeeded by Private Simons.

The station is provided with the large standard wind-vane and with the standard telescopic rod and self-registering attachments to the anemometer.

Meteorological summary.

Year.	Month.	Mean bar-ometer.	Mean ther-mometer.	Total rain-fall.	Prevailing wind.
1871..	October	30.131	73.5	<i>Inches.</i> 3.62	Northeast.
	November	30.091	65.4	3.63	Northeast.
	December	30.226	55.4	2.65	Northwest.
1872..	January	30.174	52.7	3.44	Northwest.
	February	29.993	53.9	2.70	Southwest.
	March	30.102	59.1	7.32	Northeast.
	April	30.113	73.5	2.39	Northeast.
	May	30.089	78.3	1.25	Southwest.
	June	30.072	81.0	6.97	Southwest.
	July	30.089	83.4	2.92	Southeast.
	August	30.062	81.4	6.41	Northeast.
	September	30.065	77.7	10.65	Northeast.
	Annual mean	30.101	69.6	53.95	Northeast.

KNOXVILLE, TENNESSEE.

[Latitude, 35° 55'; longitude, 83° 58'.]

No change has been made in the location of the office at this station or in the observatory. No reports have been received from other stations since October 1, 1872, previous to which date those from Knoxville were regularly received. No bulletins have been issued, but the observations are published and forty-eight reports of local observations have been furnished to the local press and published regularly.

The station has been in operation during the year, once in November, 1872, and again in May, 1873, and on both occasions the office and instruments were found in good condition. The station is provided with the standard barometer, and attached to the anemometer. Sergeant John W. Hays, professor of mathematics at the East Tennessee University, Knoxville, Tenn., has rendered all his reports regularly and in excellent condition.

Upon the subject alluded to by the public in reference to the weather reports, the following facts:

A very general interest has been and is manifested in the weather reports by almost all classes of communities. In consequence of unfinished buildings which are endangered by exposure to the weather, some contemplating trips to the country; men in charge of brick-making, who are at a loss without roof, (as it usually is;) jobbers sending goods to the country, and farmers with some sort of exposed harvests; road-builders, who are often cramped and liable to be cut away by water unless protected by some kind of arrangement on pic-nics; political meetings, camp-meetings, and others who "think of paying calls to-morrow," &c. All these classes are anxious to be "informed" to examine the probabilities, and derive benefit therefrom.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871.	October	30.135	58.0	4.28	Northwest.
		30.140	46.5	2.61	Northwest.
		30.143	37.0	3.27	Southwest.
		30.123	32.2	2.99	Northwest.
		30.097	33.0	2.24	Northwest.
		30.090	43.5	3.04	Northwest.
		30.085	53.5	3.61	Northwest.
		30.023	64.0	2.86	West.
		30.020	73.0	6.68	Southwest.
		30.010	75.0	2.29	West-NW.
		30.050	76.2	6.27	Northeast.
		30.060	67.7	3.89	Northwest.
		30.075	56.6	44.03	Northwest.

LAKE CITY, FLORIDA.

[Latitude, 30° 36'; longitude, 82° 42'.]

The station has remained unchanged during the year. Reports from ten other stations were received

and transferred to Key West and Jacksonville and northward. Since that date the only transfers made have been reports received from Key West, Punta Rassa, and Jacksonville. The failure of the telegraph company, by which communication is effected with Savannah, to keep its office open until the hour for sending the midnight report, has compelled the office to transmit the nine o'clock local observation, and has prevented any attempt to display cautionary signals on the coast of Florida. The telegraphic service of the lines running south and east from Lake City has been performed with regularity, and with as few interruptions as could be expected, considering the nature of the country through which the line passes.

No bulletins have been issued during the year. The principal value of this station consists in the fact of its being the point of transfer between the land and cable telegraph lines. The station is provided with the large wind-vane of the standard pattern, and also with the standard self-registering anemometer attachment. The station was inspected in March, 1872, and the office and instruments found in good condition.

Sergeant J. E. Magruder was in charge until April 15, when he was transferred to another station, and was succeeded by Sergeant George McDonald, who was relieved July 31, 1872, by Sergeant J. O'Dowd, who remains in charge. Private S. W. Beall was on duty as assistant until April 10, when he was ordered in for promotion, and was succeeded by Private Jones.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.044	71.0	5.03	Northeast.
	November.....	30.015	63.0	3.99	North.
	December.....	30.172	53.0	2.05	Northwest.
1871..	January.....	30.115	49.0	2.41	Northwest.
	February.....	29.961	53.5	3.02	West.
	March.....	30.041	57.6	9.59	Southwest.
	April.....	30.056	71.6	1.90	East.
	May.....	30.045	78.1	.20	Southwest.
	June.....	30.027	79.3	5.29	Southwest.
	July.....	30.048	81.2	3.86	Southwest.
	August.....	30.019	79.4	5.25	Northeast.
	September.....	30.018	76.5	4.53	East.
	Annual mean....	30.047	67.8	47.12	Southwest.

LEAVENWORTH, KANSAS.

[Latitude, 39° 21'; longitude, 94° 44'.]

No change has been made in the location of the office at this station since the date of last report. Reports from fourteen stations were received here until July 1, 1872, since which date the reports from the river stations alone have been received each afternoon. During the year four thousand five hundred and ninety-one bulletins have been issued, and one thousand four hundred and ninety-one reports furnished to the press. One paper only, the Commercial, publishes the tabular

Meteorological summary.

Year.	Month.	Mean bar-ometer.	Mean ther-mometer.	Total rain-fall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30. 099	54. 3	8. 35	Southwest.
	November.....	29. 963	37. 3	5. 50	Northwest.
	December.....	30. 049	28. 4	2. 78	Northwest.
1872..	January.....	29. 969	27. 3	2. 46	North.
	February.....	29. 938	27. 4	. 96	Northwest.
	March.....	29. 952	27. 5	2. 93	Northwest.
	April.....	30. 004	45. 2	2. 30	Northwest.
	May.....	29. 927	58. 2	3. 16	Northwest.
	June.....	29. 939	66. 8	2. 78	Southwest.
	July.....	29. 937	74. 4	5. 35	Southwest.
	August.....	30. 017	72. 6	6. 06	Southwest.
	September.....	30. 031	63. 1	6. 98	Northwest.
	Annual mean.....	29. 986	48. 5	49. 61	Northwest.

NEW ORLEANS, LOUISIANA.

[Latitude, 29° 57'; longitude, 90° 03'.]

The office was removed November 1, 1871, to the custom-house, where it still remains. It is on the third floor, and in every respect better located than before. No rent is paid for the use of the room, but the Signal-Office bore the expense of putting it in habitable condition. The wind-vane, (large,) rain-gauge, and anemometer are well exposed upon the roof of the building, and the latter instrument is provided with the standard telescopic rod and self-registering attachments. The instrument-shelter is of the standard pattern. Until July 1, the reports from thirty other stations were received here, but from that date to August 21 the work of the station was limited to making and forwarding the local observations, transferring the reports from Shreveport, Galveston, and Indianola to Augusta, and publishing the river reports received from Chicago each afternoon. Since August 21, reports from twenty stations have been regularly received.

The labor of the station has been increased by the necessity of transferring reports from the office of one telegraph company to that of another since July 1. Previous to that date the work was all done from one office. Three thousand three hundred and three bulletins and five thousand and seventy-one maps have been issued and seven hundred and fifty-eight reports furnished to the press during the year. The maps were printed on a press constructed especially for the office, but none have been issued since the suspension of the reports in July, and the press has been sent to another station. The leading papers have published the river reports, probabilities, and monthly statements regularly, and the tabulated reports occasionally. Considerable interest is manifested in the service by the citizens, especially in reference to that part of it connected with river navigation. The gauge used here for making the river observations is one put up by the city engineer.

Eight cautionary signals have been displayed during the year, of which seven are reported as having been fully justified.

Two inspections have been made during the year, one in October, 1871, and one in July, 1872. At the first inspection it was decided to

remove the office, and several irregularities in the work of the station were corrected. The office was found in better condition at the second inspection, but some changes were found necessary in the position and care of the instrument-shelter.

Sergeant D. S. Pullen was transferred to another station February 3, 1872, and succeeded by Sergeant Frank Mansfield, who still remains. During the period that maps were issued, two assistants were found necessary to perform the duties with sufficient promptness. One of these men was transferred to another station August 20, 1872. Private D. C. Ralston is now on duty as assistant.

All mail-reports have been forwarded regularly and promptly, and the telegraphic ones as regularly as the facilities attainable would permit.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.069	71.0	9.09	East.
	November.....	30.047	61.1	7.14	East.
	December.....	30.190	56.6	1.46	North.
1872..	January.....	30.195	48.7	5.10	Northwest.
	February.....	29.987	56.2	4.77	Southeast.
	March.....	30.070	59.2	9.18	Southwest.
	April.....	30.039	70.4	5.01	Southeast.
	May.....	30.070	75.8	3.14	Southeast.
	June.....	30.034	80.5	5.34	Southeast.
	July.....	30.030	82.1	6.43	Southwest.
	August.....	30.032	82.6	3.75	East.
	September.....	30.034	79.3	2.10	Southeast.
	Annual mean.....	30.066	68.6	62.51	Southeast.

NEW YORK CITY, NEW YORK.

[Latitude, 40° 42' ; longitude, 74° 1'.]

The office still remains in the Equitable Building, at 120 Broadway, but the room occupied at the date of last report proving too small for the proper discharge of the observer's duties, the company placed two desirable rooms on the same floor at his disposal, giving ample space for all necessary work connected with the interior of the office. Full midnight reports from all stations have been received here without interruption during the year; but the morning and afternoon reports from the southern stations were suspended from July 1 to August 21, when the circuit system was resumed and all reports received with regularity. Full reports from the eastern States, the Lake region, and the country west of Chicago were constantly received during the suspension of the circuit system, and after consolidation forwarded to the central office. The publication of the map was suspended from July 1 to July 20, when it was again resumed, and printed from the midnight reports, instead of the morning ones, as previously. The night reports are still used for the map in order to get it out and distributed early in the day. The latest synopsis and probabilities received are printed on the map with the detailed reports. Twenty-three thousand eight hundred and forty maps and seven thousand three hundred and fifty-five bulletins have been issued and distributed from the office during

the year, besides ten thousand additional maps printed during the fair of the American Institute, and distributed on the spot. The leading dailies, both morning and evening, publish the probabilities regularly, and occasional summaries of such reports as are of special interest. While the work of setting up the map nightly and the work of correcting it before issue is done under the supervision of the observer in charge, the actual printing is done by the Equitable Insurance Company, which has shown a generous and practical interest in the development of the service. It is expected to largely increase the daily issue of maps during the ensuing year, and also to arrange for their prompt distribution in all parts of the city.

There are three flag-staffs for the display of cautionary signals used, one on either side of the large staff belonging to the building. On the central one a wire cylinder is worked by halyards, and raised when the approach of a storm is expected; while on the smaller ones large signal-flags hoisted by day, and lanterns at night are similarly displayed. The cylinder has not worked satisfactorily, as it throws too much strain upon the staff, and other means are being devised to accomplish the purpose for which it was constructed.

Twenty-four cautionary signals have been displayed during the year, with generally satisfactory results. The signal-lights used have been found too small for display in a city where they are surrounded by numerous other lights, of nearly equal brilliancy, and others of an improved quality and larger size have been ordered and will soon be ready for use. The merchants, underwriters, and business men generally in the city have shown a gratifying appreciation of the aims of the service.

Sergeant C. R. Estabrook remains in charge of the station, and has performed the arduous and responsible duties devolving upon him with promptness, intelligence, and zeal. Sergeant A. W. Eastlake, the assistant at the date of the last report, was relieved April 8, 1872, and transferred to Washington. Two assistants are on duty at present, Privates Tighe and Lamont, both of whom are kept busily employed and give satisfaction.

The station was inspected in April, and the office and instruments found in good condition. The anemometer is provided with the standard self-registering attachment.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.130	54.8	7.07	Southwest.
	November.....	30.090	39.3	3.76	Northwest.
	December.....	30.075	30.3	1.19	Southwest.
1872..	January.....	29.997	29.9	2.34	West.
	February.....	29.968	31.8	1.44	West.
	March.....	29.986	30.3	3.93	West.
	April.....	30.014	49.7	2.49	West.
	May.....	29.994	61.9	2.25	West.
	June.....	29.942	72.8	2.93	Southwest.
	July.....	29.938	76.3	9.36	Southwest.
	August.....	30.013	75.2	6.08	Southwest.
	September.....	30.014	65.8	3.44	Northwest.
	Annual mean....	30.003	51.5	46.28	Westerly.

NORFOLK, VIRGINIA.

[Latitude, 36° 51'; longitude, 76° 19'.]

No change has been made in the location of the office at this station since the date of last report. Full reports were received here until July 1, when the discontinuance of the circuit system caused a suspension of all service to the station, except that rendered necessary for the display of cautionary signals. Two thousand one hundred and fifty bulletins and two thousand and four maps were issued, and two hundred and fifty-seven reports furnished to the press previous to July 1, 1872.

The leading dailies publish the tabular reports and monthly statements occasionally, and the probabilities regularly. The members of the meteorological committee of the board of trade have displayed considerable interest in the service, and, together with other leading citizens, have urged its extension by the establishment of a station at Cape Hatteras. Efforts were made during the past winter by these citizens to get congressional aid for the construction of a telegraph-line to the cape, but they were unsuccessful, and the project has been temporarily abandoned.

The office was inspected in June, and found in good condition.

Ten cautionary signals have been displayed at this port, eight of which are reported as having been fully justified.

Fortress Monroe has been suggested as a better place for the display of these signals, but the present condition of the telegraph cable across the harbor is not considered reliable enough to justify a change. There is a large standard wind-vane at this station, and the anemometer is provided with the standard self-registering attachment.

Sergeant William E. Smith was in charge until transferred to another station, May 4. He was succeeded by Sergeant James E. Magruder, who still remains, and has given satisfaction. Two assistants have been relieved on account of ill-health since last report. Private E. B. Robbins, at present on duty there, was ordered to the station July 9, 1872.

Meteorological summary.

Year.	Month.	Mean bar-ometer.	Mean ther-mometer.	Total rain-fall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.159	61.0	4.14	South.
	November.....	30.050	48.0	5.76	North.
	December.....	30.150	39.0	2.18	Southwest.
1872..	January.....	29.080	35.0	2.91	Northwest.
	February.....	29.980	37.0	7.33	Northeast.
	March.....	30.040	39.0	4.51	North.
	April.....	30.070	57.0	3.53	Southeast..
	May.....	30.001	68.7	5.68	South.
	June.....	30.008	76.0	5.06	Southwest:
	July.....	30.004	81.5	3.63	Southwest.
	August.....	30.058	79.2	3.20	South.
	September.....	30.050	72.6	2.40	South.
	Annual mean....	30.054	57.8	50.33	South.

OMAHA, NEBRASKA.

[Latitude, 41° 16'; longitude, 96° 00'.]

No change has been made in the location of the office at this station since last report. The reports from the stations west to the Pacific coast were received here up to July 1 and since September 1, 1872, and two thousand four hundred and sixty bulletins issued in addition to two hundred and seventy-two reports furnished the press. The daily papers publish the probabilities when received, and the monthly summaries regularly, but the tabular reports only occasionally. River reports are made from this station, the gauge used being one constructed in accordance with plans furnished from the central office. At present this gauge is unserviceable, owing to a change in the channel of the river during the year.

Two inspections have been made since last report, one in December, 1871, and the other in September, 1872. The office, instruments, and records were found in good condition at the time of the first inspection, but at the last their condition was such as to compel the immediate removal of the observer.

Sergeant W. B. Webster was in charge until transferred to another station, March 19. He was succeeded by Sergeant G. A. Dandeleit, who was relieved for incompetency, September 13, and was succeeded by Sergeant H. Barton, who is now in charge. When river reports were ordered, the distance of the gauge from the office was so great that the services of an assistant were necessary to the proper performance of this additional labor, and Private D. H. Sackett was accordingly ordered to the station, and remained until ordered in for promotion, June 17. Private George W. McKee is now on duty as assistant. Both observers, who have served during the year, have rendered all reports by mail and telegraph promptly and in proper form. The station is supplied with the large-sized standard wind-vane and with the standard self-registering attachment to the anemometer.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October	29.924	52.4	2.06	Southeast.
	November	29.955	31.0	4.22	Northwest.
	December	30.090	16.0	.91	Northwest.
1872..	January	30.130	19.0	.09	Northwest.
	February	29.940	27.5	.43	Northwest.
	March	30.022	31.0	1.61	Northwest.
	April	29.792	51.0	3.84	Southeast.
	May	29.808	61.0	6.35	South-southeast.
	June	29.794	72.7	3.91	South-southeast.
	July	29.836	77.0	6.36	Southeast.
	August	29.874	75.6	1.78	South-southeast.
	September	29.809	62.8	3.24	Southeast.
	Annual mean	29.915	48.1	34.80	Southeast.

OSWEGO, NEW YORK.

[Latitude, 43° 28'; longitude, 76° 35'.]

The location of the office at this station remains unchanged since last report. In common with the other stations on the lake circuit, Oswego received full reports until July 1, when all reports were suspended until September 1, since which date fifty-two have been received daily with as much regularity as the somewhat uncertain telegraphic communication will permit.

Two thousand five hundred and sixty-six bulletins and two thousand and eighty-six maps have been issued and seven hundred and fifty-two reports furnished the press. Selections from the tabular reports are published in most of the daily papers and the probabilities given regularly. Considerable local interest is felt in the service. The chairman of the meteorological committee of the Board of Trade stated to the inspecting officer that the reports had a great influence upon the price of grain at this port, as well as in their direct application to navigation. Mr. McWhorter, the chairman of the meteorological committee, has kept in constant communication with the central office, and has shown a desire to promote the interests of the service by making such suggestions from time to time as appeared to him necessary to improve its operations.

The office was inspected in June, and found in excellent condition. Sergeant B. F. Hough, who has been in charge since the station was established, is highly commended by the inspector for the neat appearance of his office and the intelligence displayed in the management of the station. The sergeant has constructed a self-registering attachment to the large wind-vane similar in principle to one used in the central office, from which he obtains a continuous record of the wind's movements. The anemometer is provided with both the standard telescopic rod and self-registering attachments. The assistants at this station have been men of unusually good character. Private T. B. Jennings remained until ordered in for promotion, June 17, 1872, when he was succeeded by Private McComas, who has shown commendable zeal in the service, especially in the preparation of tables for the correction of the barometrical readings.

Twenty-one cautionary signals have been displayed at this station, and all but four are reported as fully justified. In reference to the display on November 14, 15, and 16, 1871, the observer reports as follows:

The warning-signal has been of great benefit, as many vessels were detained on account of the display and thus escaped the storm. Two vessels ventured out, but encountered the gale and were obliged to put back, being considerably damaged. One vessel that went out while the signal was flying ran ashore about one mile above the port, and is now a total wreck.

The winds considered dangerous for navigation at this port are reported to be those from the northwest and west-northwest, and from the northeast when accompanied by snow and fog.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.000	53.3	1.44	South.
	November.....	29.900	34.6	2.96	Northwest.
	December.....	29.930	26.5	1.30	South.

Meteorological summary—Continued.

Year.	Month.	Mean bar- ometer.	Mean ther- mometer.	Total rain- fall.	Prevailing wind.
				<i>Inches.</i>	
1872..	January.....	29.950	26.0	1.48	West.
	February.....	29.960	23.8	1.17	Northwest.
	March.....	29.978	25.8	2.43	Northwest.
	April.....	29.953	42.7	1.44	West.
	May.....	29.872	52.7	2.72	West.
	June.....	29.918	64.2	4.48	West.
	July.....	29.883	72.2	1.84	West.
	August.....	29.959	72.8	.71	South.
	September.....	29.944	62.7	2.44	South.
	Annual mean....	29.944	46.4	24.61	West.

PHILADELPHIA, PENNSYLVANIA.

[Latitude, 39° 57'; longitude, 75° 12'.]

The office remains at 133 South Second street, as at the date of the last report. The anemometer and wind-vane are on the top of the cupola above the office, and well exposed. The vane is the large-size standard one and the anemometer is provided with the standard self-registering attachment. The rain-gauge is on the roof of the main building, and is affected to some degree by the proximity of the tower, which rises forty-five feet above it and shelters it partially from northwest storms. Measures have been taken to obtain a better location for it.

Full reports were received here until July 1, when they were wholly suspended until August 9, 1872, when the midnight report in full was received and the publication of the map resumed. On August 21 the circuit system was resumed, and full reports have since that date been received at the three regular reporting hours. The publication of the midnight map continues, in order to get it distributed before the receipt of the morning reports.

Five thousand nine hundred and fifty-nine bulletins and ten thousand five hundred and sixty-five maps have been issued and one thousand three hundred and sixty-one reports furnished the press. Several of the leading papers print the tabular report regularly, and nearly all of them occasionally. All print the probabilities regularly, and most of them the weekly and monthly statements. In reference to this subject the observer remarks, in his semi-annual report of July 1:

The advantages of our service are now attracting the most earnest consideration at this place; the shipper, the manufacturer, the merchant, and, in fact, all business men, have accepted and employed the benefits of the system in an endless number of ways in their respective occupations. That the value of the weather reports is realized by business men in their transactions is evidenced by the fact that this office is daily in receipt of letters from parties desiring to be supplied with them, and these requests have, in nearly all cases, been granted. I take pleasure in testifying to the unvarying support and efficient aid the ably conducted press of this city has ever rendered to this office in all its efforts to extend any information relating to the service.

The station was inspected in April, and the observer then in charge relieved upon the report of the inspecting officer, who considered a change necessary for the good of the service. Several changes have been made in the men on duty here during the year, all of them

with the view of benefiting the service. Sergeant Daw was transferred to another station on November 27, 1871, and was succeeded by Sergeant S. P. Carusi, who was relieved for reasons above stated April 8, and was succeeded by Sergeant George H. Richmond, who was in turn relieved for alleged improper conduct, September 13, 1872.

Sergeant W. T. Boyd is now in charge, and has two assistants, one of them being a printer, who gets out the map. Notwithstanding these numerous changes, the amount of work done at the station has been creditable to the men engaged upon it, and all reports, telegraphic and mail, have been regularly and promptly forwarded. The demand for maps here, as elsewhere, when they are printed, is steadily on the increase and keeps ahead of the ability to supply.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.140	56.5	....	Southwest.
	November.....	30.046	40.5	4.09	Northwest.
	December.....	30.146	32.9	1.57	Northwest.
1872..	January.....	30.053	29.4	.95	West.
	February.....	30.011	31.2	1.12	Northwest.
	March.....	30.054	32.1	3.67	Northwest.
	April.....	30.063	51.6	2.60	West-northwest.
	May.....	29.975	61.5	3.15	West-northwest.
	June.....	29.976	72.7	4.29	West-southwest.
	July.....	29.970	78.6	9.20	West-southwest.
	August.....	30.045	75.9	7.81	Southwest.
	September.....	30.049	67.5	3.66	Northwest.
	Annual mean....	30.044	52.5	42.11*	Northwest.

* For eleven months; rain-gauge not in position October, 1871.

PITTSBURGH, PENNSYLVANIA.

[Latitude, 40° 32'; longitude, 80° 2'.]

The office has remained in the First National Bank building, at the corner of Fifth avenue and Wood street, the only change made being the removal from one small room to two others on the same floor, better adapted for the office business.

Four thousand three hundred and fifty-eight bulletins have been issued, some of which were furnished to the press and published in whole or in part.

Fifteen reports were received here until July 1. From that date to August 21 the reports from river stations only were received each afternoon, but since the resumption of the circuit system sixteen reports are received regularly three times each day.

The station has been twice inspected since last report, once in January and again in March. Some slight irregularities were found to exist on both occasions, and immediately corrected. The instrument-shelter is a reduced copy of the observatory pattern, adopted by the central office, and answers the purpose satisfactorily. The wind-vane, (large pattern,) rain-gauge, and anemometer are well exposed on the roof of the building. River reports are made regularly from this sta-

tion, the gauge used being the standard one constructed by the city authorities, on the banks of the Monongahela a short distance above its junction with the Allegheny. Considerable interest is manifested in the service, especially by members of the press and of the Pilots' Association, and a strong desire expressed for the establishment of additional stations on the upper waters of the two rivers forming the Ohio. The probabilities are published whenever received and the river reports regularly.

Sergeant L. M. Crist was in charge until relieved, December 27, 1871, for failure to forward his mail-reports; Sergeant George N. Sullivan from that date until transferred to the central office, May 4, and Sergeant W. E. Smith, who succeeded him, still remains.

Private H. Barton was on duty as assistant until ordered in for promotion, June 17, when he was relieved by Private William Finn.

Reports have latterly been forwarded regularly and in proper form and the station is reported in good condition.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	29.955	56.0	2.66	Southwest.
	November.....	30.130	38.0	3.30	Northwest.
	December.....	30.130	30.0	2.00	Northwest.
1872..	January.....	30.180	28.0	1.85	West.
	February.....	30.102	27.0	.97	West.
	March.....	30.077	34.0	1.33	West.
	April.....	29.631	57.0	.88	North.
	May.....	29.920	63.0	2.61	Northwest.
	June.....	29.900	71.0	2.35	Northwest.
	July.....	29.910	75.0	7.70	West.
	August.....	29.980	74.0	2.81	West.
	September.....	29.980	66.0	2.54	West.
	Annual mean	29.991	51.6	31.00	West.

PORTLAND, MAINE.

[Latitude, 43° 40'; longitude, 70° 14'.]

No change has been made in the location of the office during the year, nor is any considered necessary at present. Full reports were received here until the suspension of the circuit system, July 1, since which date none have been received, owing to the difficulty of making the necessary telegraphic arrangements.

Two thousand six hundred and six bulletins and one thousand nine hundred and thirteen maps have been issued and seven hundred and fifty reports furnished to the press and published in condensed form. The probabilities and monthly summaries are published regularly and considerable interest manifested in the service by leading citizens, and Mr. Farley, chairman of the meteorological committee of the Board of Trade, has rendered much valuable assistance to the observer in various ways during the year.

Twelve cautionary signals have been displayed at this port during

the past year, and seven of this number were fully justified. As to the result of the different warnings the observer reports as follows:

November 1, 1871.—The violence of the gale was not felt at this station, but was reported as being very severe off the coast. On account of the display, many vessels remained in the harbor which otherwise would have put to sea, where they would have encountered the storm.

November 10, 1871.—No injuries to shipping are reported, as timely preparations for the storm had been made.

November 14, 1871.—By the timely display of the signal a number of vessels that were making preparations to leave the harbor during the evening were detained, thereby escaping the gale.

December 4 and 5, 1871.—Owing to the display of the signal, the regular steamers to New York and ports east remained in harbor until the violence of the gale subsided.

The office was inspected in May, and numerous irregularities in the management of the station and the location of the instruments and the manner of keeping the records discovered, all of which were corrected. The rain-gauge, wind-vane, (large pattern,) and anemometer are well exposed on a raised platform upon the roof, and the last-named instrument is provided with the standard telescopic rod and self-registering attachments.

Sergeant R. E. McGrady was relieved from charge of the station, August 17, and transferred to Louisville, Kentucky, being succeeded by Sergeant A. B. Williams, who still remains. Private N. Phelps is on duty as assistant, having relieved Private Ramsay, who was transferred to Mount Washington, June 17, 1872. Mail and telegraphic reports have been forwarded promptly and in proper form, so far as the observer is concerned, but the midnight reports have been delayed until the next morning by the closing of the telegraph-office at night since July 1.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871.	October.....	30.053	50.0	6.55	Southwest.
	November.....	29.926	33.0	6.37	Northwest.
	December.....	30.004	23.0	3.00	Southwest.
1872.	January.....	29.910	22.5	.77	Southwest.
	February.....	29.924	23.0	.35	Northwest.
	March.....	29.900	23.3	1.44	Northwest.
	April.....	29.949	41.8	1.60	Northwest.
	May.....	29.955	52.3	3.23	South.
	June.....	29.950	62.0	5.95	South.
	July.....	29.919	68.7	2.97	South.
	August.....	30.007	67.1	6.97	Southwest.
	September.....	30.020	59.8	3.12	Southwest.
	Annual mean.....	29.963	43.9	42.32	Southwest.

PORTLAND, OREGON.

The office is located in Gilman's Building, at the corner of First and Alder streets, in the center of the business part of the city and within easy reach of the telegraph-office. The wind-vane, (large pattern,) rain gauge, and anemometer are well exposed on the roof of the building. The instrument-shelter is of the standard pattern, and projects from a window with a northern exposure. The station was established

by Sergeant Edwin Garl, and who began to send reports November 1, 1871. The only reports received at the station were those of San Diego and San Francisco, on the Pacific coast, previous to July 1. Since that date the work of the observer has been limited to making and forwarding the local observations. The telegraphic communication with San Francisco, where the reports are transferred eastward, has been frequently interrupted. In addition to this difficulty, the telegraph-office has been closed at the hour for sending the morning and night reports since July 1, causing great irregularities in their transmission.

Four hundred and eighty bulletins have been issued and two thousand one hundred and eighty-seven reports of the local observations furnished the press and regularly published.

The station is supplied with a full set of standard instruments, all of which are reported in good condition. An officer is now on his way to inspect the station.

All mail-reports have been forwarded promptly and in proper form.

Latitude of station..... 45° 30'
Longitude of station..... 122° 27'
Elevation of barometer above sea-level..... 97 feet.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....				
	November.....	30.060	45.0	2.77	Southeast.
	December.....	30.040	38.0	7.62	Southeast.
1872..	January.....	30.160	36.0	6.56	Southeast.
	February.....	29.900	44.0	12.13	Southeast.
	March.....	30.130	48.0	5.28	South.
	April.....	30.150	47.0	2.96	South.
	May.....	30.130	57.0	.92	Northwest.
	June.....	30.090	64.0	1.52	Northwest.
	July.....	30.040	68.0	.20	Northwest.
	August.....	30.060	66.0	.13	Northwest.
	September.....	30.063	59.0	1.26	Northwest.
	Mean for 11 mos...	30.075	52.0	41.35	Northwest.

PUNTA RASSA, FLORIDA.

[Latitude, 27° 00'; longitude, 82° 18'.]

The location of the office at this station has not been changed since last report, there being no other building in the place. The room is small and somewhat crowded, but is the best that could be had, and for its use the office is under obligation to the International Ocean Telegraph Company, whose property it is.

The station was inspected in February, and found without a proper shelter for the exposure of instruments. One was ordered by the inspector from Key West, the nearest place where it could be obtained. Other irregularities were corrected, and the office left in as good order as could be expected. No reports are received here for publication and no bulletins issued.

Sergeant C. E. Ingram was relieved from charge of the station, Feb-

ruary 27, and his successor, Sergeant George S. Rowley, September 5, both upon the report of the superintendent of the telegraph company that they had been guilty of misconduct. Sergeant William Theodovius was ordered to the station, September 5. Private John Healy was assigned to duty here as an assistant, February 27, and still remains for the purpose of preventing interruption of the reports through sickness of the observer.

All mail-reports have been forwarded with regularity and the duties of the station in relation to office-work discharged satisfactorily. The station is supplied with a medicine-chest, furnished by the Medical Department of the Army, for the observer's use, and is comfortably fitted up with such furniture as could be obtained from Key West. Every effort has been made to render the duty here as pleasant as practicable at such an isolated post.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rain-fall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October	30.035	79.8	1.80	Northeast.
	November	30.040	71.5	.98	Northeast.
	December	30.180	67.0	2.68	Northeast.
1872..	January	30.140	62.5	2.64	Northeast.
	February	30.030	64.0	2.71	Northeast.
	March	30.080	69.0	.69	South.
	April	30.080	77.0	1.54	Northeast.
	May	30.090	78.0	2.88	Northeast.
	June	30.077	80.9	7.16	West.
	July	30.090	81.0	8.68	Northeast.
	August	30.045	81.0	3.97	Northeast.
	September	30.020	80.0	5.14	Northeast.
	Annual mean	30.076	74.3	40.87	Northeast.

ROCHESTER, NEW YORK.

[Latitude, 43° 08'; longitude, 77° 51'.]

The office remains in Power's Block, at the corner of West Main and State streets, in the center of the business part of the city. The building is fire-proof, being built of iron, stone, and brick, and, although the office has been on the eighth floor since September 1, it is reached easily by means of an elevator. Previous to September 1 it was on the sixth floor, but the additional stories being added by the proprietor, it was moved at his request and at his expense.

The anemometer provided with the standard telescopic rod and self-registering attachments, the rain-gauge, and large wind-vane are well exposed on the roof of the building, and the signal-staff is sufficiently elevated to be visible from Charlotte, the port of the city, six miles distant. The instrument-shelter is a modified copy of the observatory adopted at the central office, and is on the roof of the building.

Previous to July 1 full reports, and since September 1, fifty-two reports have been received with as much regularity as at the other lake stations. Three thousand eight hundred and sixty-nine bulletins and one thousand eight hundred and seventy-three maps have been

issued and five hundred and eleven reports furnished to the press. The leading papers publish the tabular report, the probabilities, and the weekly and monthly summaries. Mr. Powers, the proprietor of the building, has displayed a lively interest in the service and done all in his power to make the office perfect in its appointments at some personal expense.

The station was inspected on July 1, and the office and instruments found in good condition. Sergeant F. M. M. Beall has been in charge since its establishment and has rendered all reports promptly and in proper form. He is highly commended by the inspecting officer as attentive to his duties and always ready to give information to applicants. The assistant, Private L. M. Crist, is also favorably mentioned.

Thirteen cautionary signals were displayed at this point, and all but three are reported as fully justified. In reference to known benefits or injury to commercial or other interests, resulting from the display of signals, the observer reports as follows:

December 3, 1871.—People look up to the signal with expectation and confidence, on account of the accuracy that marks its predictions.

April 13, 1872.—Signal ordered on the 12th instant was hoisted twenty hours before the gale commenced. This being the first display of the season, many persons called to ascertain the probable time and severity of the expected gale. At 2 p. m., the wind, blowing from the west, reached a velocity of sixty-two miles per hour. Considerable damage was done to property, and from personal inquiry I find many builders governing their operations by it, and gladly acknowledged the benefit of the signal. All the city papers acknowledged its timely warning. The steamer Norseman made her regular trip on the 13th, but encountered very high and dangerous seas.

The winds considered dangerous at this station are those from the northeast to the northwest.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.100	51.0	2.59	West.
	November.....	30.010	32.0	3.10	Northwest.
	December.....	29.960	24.0	1.82	West.
1872..	January.....	29.950	23.5	2.37	West.
	February.....	29.950	23.0	1.28	Southwest.
	March.....	29.950	22.0	2.50	Northwest.
	April.....	29.920	44.0	2.15	Northwest.
	May.....	29.890	54.0	2.18	West.
	June.....	29.880	65.0	5.35	West.
	July.....	29.890	71.0	2.56	West.
	August.....	29.960	71.0	1.89	Southwest.
	September.....	29.960	62.0	1.72	Southwest.
	Annual mean.....	29.952	45.2	29.51	West.

SAN DIEGO, CALIFORNIA.

The office is located in the second and upper story of a building on the south side of Horton Square, within easy reach of the post and telegraph offices, and the roof affords an excellent exposure for the wind-vane and anemometer. The instrument-shelter is of the standard pattern, and projects from a window having a northwestern exposure.

The station was established by Sergeant John B. Wells, who began

sending reports November 1, 1871, and has kept them up since that date with as much regularity as the condition of the telegraph-line would permit. Since July 1 the closing of the telegraph-office at the hours for sending the morning and midnight reports has been an additional cause of delay. Previous to July 1 the reports of San Francisco, and Portland, Oregon, were received, but at present the work of the observer is limited to the transmission and publication of the local observations.

Five hundred and ninety-eight bulletins and seventy-two reports have been issued and published regularly. The observer remarks as follows upon the local interest manifested in the service:

Semi-annual report of July 1, 1872.—The importance accredited to this branch of the signal-service by the commercial and agricultural public and the zealous interest manifested by all classes in its wonderful development and success are fully demonstrated by the confidence with which the general public are pleased to receive our official reports and the favorable expressions of numerous persons from all parts of the country, generally here for their health, who take the occasion to visit my office. Among my visitors I take pleasure to mention General Meigs, U. S. A., General Alexander, of the Engineer Corps, and a number of other Army and also Navy officers on different occasions. * * * The wonderful equality of this climate, produced as it is by the almost constant westerly winds, which receive their temperature from their passage over the vast expanse of the Pacific, attracts invalids suffering from pulmonary complaints in great numbers from all parts of the country, where they find relief in the peculiar qualities of this dry, bracing atmosphere, and their lives are often prolonged in this climate, where extremes of heat and cold are unknown. Intelligent physicians, in recommending their patients to an agreeable climate, are guided or influenced in selecting a location by our published reports.

Latitude of station 32° 44'
Longitude of station 117° 06'
Elevation of barometer above sea-level 62 feet.

The station is supplied with a full set of standard instruments, all of which are reported in good condition.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	November.....	30.011	59.7	1.19	West.
	December.....	30.133	56.5	1.39	Northwest.
1872..	January.....	30.091	51.9	.99	East.
	February.....	30.086	54.7	1.63	West.
	March.....	30.031	56.2	.46	West.
	April.....	30.054	56.3	.26	West.
	May.....	30.004	60.8	.12	West.
	June.....	29.974	65.2	.00	West.
	July.....	29.975	66.6	.00	West.
	August.....	29.955	68.9	.18	West.
	September.....	29.984	66.4	.00	West.
	Mean for 11 months.	30.027	60.3	6.22	West.

SAN FRANCISCO, CALIFORNIA.

[Latitude, 37° 48'; longitude, 122° 26'.]

No change has been made in the location of the office since the date of last report. Previous to July 1 and since September 1, reports from

eleven stations have been received here, and reports from San Diego, and Portland, Oregon, regularly transferred to Chicago and eastward.

One thousand nine hundred and twenty-four bulletins and four hundred and four press-reports have been issued. The daily papers occasionally publish the tabular reports and monthly summaries.

The anemometer is supplied with the standard self-registering attachment.

Sergeant S. P. Carusi was relieved from charge of the station, October 16, 1871, and was succeeded by Sergeant F. B. Pilling, who is still at the station, but has been unfit for duty on account of serious illness since March 19, 1872, the work having been ably performed in the mean time by Sergeant W. B. Webster, transferred here from Omaha.

All reports by mail have been sent regularly and in proper form since the latter took charge, and the telegraphic ones as regularly as the condition of the lines permitted. The instruments are all reported in good condition. There is no assistant at this station at present, but one will be sent at an early date to insure the transfer of reports in the event of the observer's sickness.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October	29.990	65.5	.07	Southwest.
	November	30.070	53.0	2.81	West.
	December	30.090	53.0	14.36	Southwest.
1872..	January	30.120	52.0	4.03	North.
	February	30.090	56.0	6.90	Southwest.
	March	30.106	54.2	1.59	West.
	April	30.079	53.7	.81	West.
	May	29.986	56.3	.18	Southwest.
	June	29.991	59.9	.04	Southwest.
	July	29.974	58.0	.01	Southwest.
	August	29.945	56.4	.00	Southwest.
	September	29.984	58.7	.04	Southwest.
	Annual mean	30.035	56.4	30.84	Southwest.

SANTE FÉ, NEW MEXICO.

The office is on the upper floor of a two-story building known as Johnson's Building, on a street without name or number. The roof is flat and affords a good exposure for the wind-vane, (small pattern,) anemometer and rain-gauge, and also for the instrument-shelter, which is a small structure of lattice-work elevated above the roof.

The station was established by Sergeant John P. Clum, who began sending reports November 20, 1871, and has continued to do so since that date with as much regularity as the condition of the telegraph-line would permit.

Mail communication has also been unreliable, causing frequent delays in the receipt of reports sent by mail. The station has not been inspected, but the observer reports all instruments in good condition. The work of the office has been done without an assistant.

Latitude of station 35° 41'
 Longitude 106° 3'
 Elevation of barometer above sea-level..... 6,850 feet.

No bulletins have been issued, as no reports from other stations are received. The monthly summaries have been published by the press with regularity, and some local interest manifested in the service, mainly in the expression of a desire for more reports.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	December.....		34.3		North.
1872..	January.....	29.770	27.0	.34	North.
	February.....	29.733	34.0	.20	North.
	March.....	29.735	38.8	.13	North.
	April.....	29.725	45.8	.14	Southwest.
	May.....	29.851	58.1	.45	North.
	June.....	29.883	66.9	2.44	Southwest.
	July.....	29.925	67.6	2.62	Northeast.
	August.....	29.970	67.0	2.98	South.
	September.....	29.910	60.0	.27	Southeast.
	Mean.....	29.834	49.9	9.57	North.

SAVANNAH, GEORGIA.

[Latitude, 32° 05'; longitude, 81° 08'.]

No change in the location of the office has been made during the year, and full reports were received until the suspension of the circuit system, since which date the only ones received are those from the Florida stations.

Two thousand nine hundred and seventy-one bulletins, two hundred and fifty press reports, and one thousand four hundred and sixty-nine maps have been issued and distributed throughout the city. The leading papers publish the probabilities and monthly statements regularly. The station has been twice inspected since last report, once in October, 1871, and again in March, 1872, and found in good condition on both occasions, the slight irregularities discovered in the manner of keeping the records and caring for the instruments being easily corrected.

The large wind-vane is well exposed, and the anemometer is provided with the standard telescopic rod and self-registering attachments.

Leading merchants and shippers have manifested a lively interest in the service and expressed themselves as having derived much practical benefit from observation of the reports. A general desire is also expressed for the resumption of the bulletins.

Four cautionary signals have been displayed at this station, all of which are reported as fully justified. The observer reports upon the result of the several displays as follows:

November 15, 1871.—The display prevented several ships and other craft from going to sea, and from information I learn there was a heavy gale along the immediate coast.

November 30, 1871.—Several vessels were detained from leaving port in the immediate vicinity of Savannah; there was a wind from twelve to twenty miles per hour.

Sergeant C. W. Held was in charge until transferred to a northern station, January 15, 1872, when he was succeeded by Sergeant J. O. Manson, who still remains. Both men have given satisfaction by the promptness and regularity with which they have rendered all reports. Private J. K. P. Purdum is still on duty as assistant, and is highly commended by the inspecting officer for his zeal and intelligence.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October	30.142	68.3	3.55	Northeast.
	November.....	30.061	59.1	2.22	Southwest.
	December.....	30.215	51.5	1.59	Southwest.
1872..	January.....	30.160	46.0	2.09	Northwest.
	February.....	30.000	50.0	4.65	Northwest.
	March.....	30.078	53.5	10.18	Northwest.
	April.....	30.103	67.0	2.75	East.
	May.....	30.060	76.0	5.22	Southwest.
	June.....	30.045	80.0	9.52	Southwest.
	July.....	30.060	83.0	4.36	Southwest.
	August.....	30.060	84.0	12.31	East.
	September.....	30.060	76.0	3.52	Southeast.
	Annual mean.....	30.087	66.2	61.96	Southwest.

SHREVEPORT, LOUISIANA.

[Latitude, 32° 30'; longitude, 93° 45'.]

The office is on the fourth floor of the Southern Hotel, on Milan street, in the business center of the town. The roof affords an excellent exposure for the wind-vane, (large pattern,) anemometer, and rain-gauge, and they are well and firmly set up. The shelter is of the standard pattern, and projects from a window having a northern exposure.

Two inspections have been made during the year, one in November, 1871, and the other in August, 1872, and such slight irregularities as were discovered in the arrangement of the instruments and manner of keeping the records corrected.

River reports are made from this station, the gauge used being one constructed by the observer in accordance with plans furnished from the central office. Owing to the fact that it was put up during high water it has failed to prove serviceable during the summer season, and a new one will be required. The reports from this station are considered of importance by shippers on the Mississippi from New Orleans to Saint Louis, and special pains will be taken to render them accurate and trustworthy.

Seventy bulletins and six hundred and forty-five press reports have been issued. The local observations are published by the principal papers.

Sergeant Hugh Coyle has been in charge of the station since November 6, 1871, and is highly commended by the inspecting officer for his attention to duty. All reports have been sent regularly and in proper form. Some delay in the transmission of the midnight reports has occurred since July 1, by the closing of the telegraph-office at the

regular hour for sending them. To guard against any interruption of the reports an assistant was ordered to the station, August 2, 1872.

The observer gives the following illustration of the practical legal value of the reports:

In the month of February last something occurred here which may be stated as an indication of the esteem in which our service is held by the intelligent public.

A man was on trial at the district court for murder. A skiff (boat) was one of the things found upon the scene of the supposed murder. It was alleged upon trial that the boat had drifted with the wind in a certain direction to a certain place. Something was said about freezing water, ice in the river, and evaporation on the day the dead body was found, but these allegations were not generally accepted as facts, and a contradiction ensued. The mind of a wide-awake attorney soon perceived that these questions could be determined with scientific accuracy and reliability by means of the Signal-Service records at this station. On the 19th of February my office was visited by two lawyers in quest of information from said records, and the same day I received a citation from the district court to appear immediately with the records of the weather for November 28 and 29, 1871. I was sworn to give true evidence in the case, which was decided by the information obtained from the daily record of observations.

Meteorological summary.

Year.	Month.	Mean bar-ometer.	Mean ther-mometer.	Total rain-fall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October*.....				
	November.....	30.051	51.1	3.04	East.
	December.....	30.167	47.7	1.30	South.
1872..	January.....	30.211	40.7	5.25	East.
	February.....	29.966	50.6	5.89	West.
	March.....	30.064	54.4	4.11	South.
	April.....	29.984	66.5	7.18	Southeast.
	May.....	30.018	73.5	9.10	Southeast.
	June.....	30.002	80.4	2.70	South.
	July.....	29.981	84.0	1.62	South.
	August.....	30.019	84.5	.40	East.
	September.....	30.002	78.6	2.91	Southeast.
	Mean for 11 months.	30.043	64.7	43.50	South.

* Records incomplete.

SAINT LOUIS, MISSOURI.

[Latitude, 38° 37'; longitude, 90° 16.']

No change has been made in the location of the office since last report, but one is contemplated at an early day, to a building much more favorably located for meteorological purposes. The large wind-vane, rain-gauge, and anemometer are elevated above the roof on a strongly-built platform, and are substantially put up. The latter instrument is provided with the standard telescopic rod and self-registering attachments.

The instrument-shelter is of the standard pattern, and projects from a window with a northern exposure. The station was inspected in November, 1871, and in August, 1872, and found in good condition on both occasions.

Fifteen reports were received here tri-daily until July 1, after which the same number of river reports were received each afternoon until August 21, when, the circuit system being resumed, the number of reports was increased to twenty-seven, to be received three times each day.

Reports to and from Leavenworth and Cairo are here transferred under the observer's supervision.

Fourteen thousand and thirty bulletins and river reports have been issued and four thousand five hundred and twenty-four reports furnished to the press. The leading dailies publish the tabular reports in full, and the probabilities, river reports, and monthly summaries regularly and in excellent form.

The inspector reports that the citizens are very desirous of having full reports furnished them and a daily map issued, and in compliance with their wishes and his recommendation arrangements are making for such issue, which will be completed at an early day.

The members of the meteorological committee have taken an active interest in the office and render valuable assistance to the observer in various ways. They urge the extension of the system by the addition of several other stations at the mouths of the principal tributaries of the Missouri and Mississippi Rivers, to give timely notice of the approach of floods from those sources. They also desire more stations to the westward, on account of the large carrying business done over the Pacific Railroad. The river reports are of special importance to this station on account of its large river trade, and special messengers are furnished the observer by the chamber of commerce to assist in their wide and prompt distribution.

The water-gauge is set up at the wharf of the Saint Louis Elevator Company, and was constructed by the observer in accordance with plans furnished from the central office. It agrees with that of the Pilots' Association, and its indications are considered reliable.

Saint Louis was designated as a recruiting station for the signal detachment, and the observer instructed to examine applicants for admission to this service and turn over all candidates accepted to the recruiting officer for enlistment and transfer to Washington. The number of applications was unexpectedly large, and the increased amount of work thus thrown upon the observer necessitated the presence of another assistant to enable him to perform this duty and keep up his regular station-work, and one was, accordingly, ordered here in March, and still remains. The following statement shows how energetically the observer has carried out his duties in this direction :

Number of applicants by mail and in person.....	1, 356
Number of men examined.....	845
Number of men examined who passed examination and were enlisted.....	103

Sergeant E. H. Singleton has been in charge of the station, and has displayed in its management, and in his unremitting attention to duty, soldierly qualities of a high order. Referring to him the inspecting officer says :

He seems to have conducted his station in the best manner possible, and to have given the people every facility to obtain such information as they desired. He enjoys a high character in the community.

Privates P. J. Huneke and Thomas G. White are on duty as assistants, and are both applicants for promotion.

Meteorological summary.

Year.	Month:	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.041	60.5	2.07	South-southwest.
	November.....	30.065	40.2	1.83	Northwest.
	December.....	30.090	30.5	1.17	Southwest.
1872..	January.....	30.160	28.3	.64	Southwest.
	February.....	30.010	32.4	1.15	East.
	March.....	30.057	39.1	2.43	Northwest.
	April.....	29.947	57.5	3.17	Southeast.
	May.....	29.960	67.4	5.97	South.
	June.....	29.949	76.9	4.26	South.
	July.....	29.948	79.0	4.41	Southeast.
	August.....	30.006	74.9	.93	Southeast.
	September.....	29.965	69.8	3.45	Southwest.
	Annual mean....	30.017	55.1	31.50	Southerly.

SAINT PAUL, MINNESOTA.

[Latitude, 44° 53'; longitude, 93° 05'.]

The office was removed, December 27, 1871, to the third floor of the building at the corner of Third and Market streets. The vane, (large pattern,) rain-gauge, and anemometer are well exposed on the roof of the building, and the latter is provided with the standard self-registering attachment and telescopic rod. The instrument-shelter is of the standard pattern, and projects from a window having a northern exposure.

Ten reports were received here regularly until July 1, since which date those from the river stations alone have been received each afternoon. Some delays in the transmission of the morning and midnight reports have occurred since July, but arrangements have been made which it is hoped will prevent their future recurrence, except from accidental causes.

Eight hundred and thirty-four bulletins and two hundred and thirty-five press reports have been issued. The principal papers publish extracts from the tabular reports, and the probabilities and monthly summaries in full.

Considerable interest is manifested in the service by the citizens, and a strong desire expressed to have the station furnished with full reports for the benefit of the agricultural community.

River reports have been made since January 1, the observation being taken from a gauge constructed in accordance with plans furnished from the central office.

The office has been twice inspected during the year—once in December, 1871, and again in September, 1872. At the first inspection the condition of the office was such as to lead to its removal to a better location and the discharge of the observer. At the second inspection the office and instruments were found in good order, and the conduct of the observer commendable.

Sergeant I. V. Munger was relieved January 15, and was succeeded by Sergeant C. W. Held, the present incumbent. All mail reports have been forwarded promptly and in proper form.

Meteorological summary.

Year.	Month.	Mean bar-ometer.	Mean ther-mometer.	Total rain-fall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.032	47.3	1.90	Northwest.
	November.....	30.117	27.8	1.41	North.
	December.....	30.128	9.9	1.20	Southwest.
1872..	January.....	30.077	15.1	.28	Northwest.
	February.....	30.002	20.3	.26	Southeast.
	March.....	30.121	21.9	1.64	Northwest.
	April.....	29.876	45.1	1.69	Southeast.
	May.....	29.922	55.2	5.71	West.
	June.....	29.849	67.9	3.81	Southeast.
	July.....	29.919	71.2	4.23	South.
	August.....	29.974	69.2	3.52	South.
	September.....	29.889	57.6	5.62	East.
	Annual mean....	29.992	42.4	31.27	Southerly.

TOLEDO, OHIO.

[Latitude, 40° 39'; longitude, 83° 32'.]

Full reports from all stations were received until the suspension of the circuit system, July 1. Since September 1 those from fifty-two stations have been received as regularly as the telegraphic facilities at the command of the office would permit.

Three thousand eight hundred and twenty-nine bulletins and one thousand six hundred and sixty-three maps have been issued, and a general interest is manifested in the service by members of the press and leading citizens. The station has not been inspected during the year, and a detailed account of its condition cannot, therefore, be given.

The anemometer is provided with the standard telescopic rod and self-registering attachments, and all instruments are reported by the observer to be in good working order.

Twenty-five cautionary signals have been displayed with good results; fifteen being fully justified, and most of the others partially so.

Sergeant A. C. Ford remains in charge, and has rendered all reports promptly and in proper form.

Private Davis was relieved November 10, 1871, for misconduct, and his successor, Private G. A. Dandeleit, promoted and transferred, March 19, 1872.

The present assistant, Private W. H. Colesberry, is reported as efficient and attentive to duty.

Meteorological summary.

Year.	Month.	Mean bar-ometer.	Mean ther-mometer.	Total rain-fall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.035	55.0	.87	Southwest.
	November.....	30.077	35.0	1.48	Northwest.
	December.....	30.062	26.0	1.91	Southwest.
1872..	January.....	30.066	26.0	1.20	Southwest.

Meteorological summary—Continued.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
1872..	February	30.012	24.0	<i>Inches.</i> 1.10	Northeast.
	March.....	30.042	30.0	1.68	Northwest.
	April.....	29.977	49.9	1.87	Northwest.
	May.....	29.947	60.0	3.97	Southwest.
	June.....	29.923	71.9	3.96	Southwest.
	July.....	29.914	76.0	5.76	Southwest.
	August.....	29.982	75.3	1.16	Southwest.
	September.....	29.941	64.8	3.38	Southwest.
	Annual mean....	29.998	49.5	28.25	Southwest.

VICKSBURGH, MISSISSIPPI.

[Latitude, 32° 24'; longitude, 91° 00'.]

No change has been made in the location of the office since the establishment of the station, but one is proposed, October 1, 1872, to secure a better exposure of the instruments, at a less expense than at present.

The same number of reports are received here as at the other stations on the river circuit, and has varied from time to time as at those stations.

Three thousand five hundred and eighty bulletins have been issued, and seven hundred and thirty-four reports furnished the press. The station was inspected in August, and several changes found necessary in the location of instruments and manner of caring for them. The records have been neatly kept, so well, indeed, as to receive special commendation from the inspecting officer.

The construction of a new and better instrument-shelter has been deferred until the removal of the office to its new location.

River reports have been regularly made since January 1, the gauge used being one constructed by the United States Engineer Corps, and is considered reliable, though badly located.

Considerable interest is manifested by the citizens in the river reports, owing to the fact that the principal business of the city is connected with the river trade.

Sergeant R. R. Martin has remained on duty since the station was established, and has given satisfaction by the prompt and correct rendition of all reports. A special series of observations, made voluntarily by him, have been placed on file in the central office, as evidence of his zeal in the service. Private Max Marix was on duty as assistant until ordered in for promotion, April 10, 1872, when he was succeeded by Private R. McLaughlin, who still remains. Both men are favorably mentioned by the inspector.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
1871..	October.....	30.170	67.0	<i>Inches.</i> 4.13	East.
	November.....	30.102	54.7	7.03	Northwest.
	December.....	30.231	50.1	2.05	Southeast.
1872..	January.....	30.262	42.7	3.24	Northeast.

Meteorological summary—Continued.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1872..	February	30.032	52.6	5.34	Southeast.
	March.....	30.118	56.0	7.82	North.
	April	30.053	69.2	7.79	Southeast.
	May	30.081	75.2	13.23	Southeast.
	June	30.056	81.6	3.82	Southwest.
	July	30.046	83.5	2.11	Southwest.
	August	30.075	84.6	.49	North.
	September	30.072	79.7	.72	Southeast.
	Annual mean....	30.108	66.4	57.77	Southeast.

VIRGINIA CITY, MONTANA.

The office is located in the Crescent Hotel, on Wallack street, and the instruments are reported by the observer as well exposed, but the report of the inspecting officer has not yet been received, so that no detailed description of the office can be given.

The station was established by Sergeant A. B. Knight, who began reporting November 25, 1871, and has continued to do so since, as regularly as the uncertain telegraphic communication would permit. The reports from Fort Benton are received here when the line is in working order.

Three hundred and sixty-four bulletins have been issued, and four hundred and twenty reports of local observations furnished the press, all of which have been published regularly.

The mail reports have been rendered neatly, and in excellent form, but not with sufficient promptness, and the report of the inspecting officer is expected to account for the delay.

There is a full set of standard instruments at this station, all of which are reported in good condition by the observer.

Latitude of station..... 45° 18'
Longitude 112° 03'
Elevation of barometer above sea-level..... 5,510 ft.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	December	29.039	20.2	1.43	West.
1872..	January	29.768	20.3	1.45	Southeast.
	February	29.579	26.6	.79	West.
	March	29.683	31.3	.20	West.
	April	29.627	34.3	.35	Northwest.
	May	29.721	46.6	1.78	West.
	June	29.728	55.6	.74	West.
	July	29.839	58.4	2.73	Southeast.
	August	29.838	61.3	.60	West.
	September	29.880	50.4	.28	West.
	Mean for 10 months.	29.670	40.5	10.35	West.

WASHINGTON, D. C.

[Latitude, 38° 53'; longitude, 77° 01'.]

Several important changes have been made during the year in the arrangement of the central office. The building occupied at the date of the last report proving too small for the rapidly-increasing work of the office, the one immediately adjoining was rented in November, and an additional story put on both buildings. The addition of the new story compelled the removal of the observatory previously used as the instrument-shelter, as the roof was not strong enough to bear its weight with that of the several instruments and apparatus necessarily exposed upon it. A new shelter was, therefore, built, projecting from a window on the northern side of the building. The whole of the upper story is used for the examination, comparison, and adjustment of all instruments purchased by the office, whether for local use or issue to stations. Paper D, herewith, gives a detailed description of the different self-registering instruments not previously described, and the manner of using them. A complete record of each instrument issued is kept, showing its error, date of issue, and all changes made thereafter, as reported by the party receiving it. In the photographic room a series of cloud-views has been made, in addition to the regular work upon the photographic registering-apparatus.

Sergeant George C. Schaeffer still has charge of the immediate comparison of station-instruments, under the supervision of a commissioned officer, who has charge of this department of the office.

The station-work proper is done on the third floor, where all telegraphic reports are translated, bulletins written, and, with the large daily edition of the weather-map, regularly issued. In this room all the reports received by mail from all stations are examined, corrected, and filed for future reference.

Sergeant D. J. Gibbon was in charge of the station until commissioned as second lieutenant, U. S. A., March 4, 1872, when he was succeeded by Sergeant Theodore Smith, who has performed the arduous and responsible duties connected therewith in an able and satisfactory manner.

A large amount of correspondence relating to the management of the distant stations is also done in this room, Sergeant James B. Newlin remaining in charge of this branch of work, as at last report.

During the year sixteen thousand and sixty-four bulletins and one hundred and seven thousand eight hundred and eighty-eight maps have been issued, and two thousand nine hundred and twenty reports furnished to the press.

As the care of the numerous instruments and a proper regard for the safety of the whole building required the constant presence of some responsible man, the working force was divided May 1 into three reliefs of eight hours each, and a sergeant placed in charge of each relief, whose duty is to personally examine the instruments and rooms every hour to see that everything is safe. As a precaution against fire, a "Babcock fire-extinguisher" and water-buckets, kept constantly filled, are placed on each floor of each building. A fire-alarm box is attached to the front of the building.

The map-printing was done on the third floor until May 1, when the room becoming too small for the purpose, the press was moved to a larger room in another building near the main office. In addition to printing the maps, a large amount of other work has been done.

Sergeant John T. Downes remains in charge of this division of the office, and has been faithful and regular in the discharge of his duties.

The work of lithographing the isobars and isotherms upon the tri-daily weather-map is done in the same building with the map-printing, and is under the immediate charge of Private P. F. Nagle, who has shown commendable energy and skill in the performance of this duty.

The last reports in the morning are frequently not received until half-past ten o'clock, and the maps, five hundred and fifteen in number, are required to be ready for delivery by half-past eleven daily. As each map passes twice through the lithographic and once through the printing press, and both are worked by hand, the speed attained is considered very creditable to the men employed.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rain-fall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October	30. 143	55. 5	1. 50	South.
	November	30. 068	42. 4	4. 85	Northwest.
	December	30. 142	32. 3	1. 36	Northwest.
1872..	January	30. 147	32. 7	. 23	Northwest.
	February	30. 029	34. 0	. 93	Northwest.
	March	29. 999	36. 0	3. 22	Northwest.
	April	30. 059	56. 2	1. 74	Northwest.
	May	29. 979	67. 8	1. 43	Northwest.
	June	29. 966	76. 0	2. 78	South.
	July	29. 877	81. 7	. 82	South.
	August	30. 025	79. 6	5. 72	South.
	September	30. 075	69. 3	3. 92	Northwest.
	Annual mean	30. 042	55. 3	28. 50	Northwest.

WILMINGTON, N. C.

[Latitude, 34° 11'; longitude, 78° 10'.]

The location of the office remains unchanged since date of last report. No reports from other stations have been received here since July 1. Previous to that date all were received with regularity.

The station is provided with the large standard wind-vane, and the standard telescopic rod and self-registering attachments to the anemometer.

Two thousand five hundred and forty-five bulletins and one thousand seven hundred and twenty-four maps have been issued, and two hundred and fifty reports furnished the press. The principal papers publish extracts from the tabular reports daily, when they are received, and continue to publish the probabilities and monthly summaries with regularity.

The meteorological committee of the Chamber of Commerce urge the construction of a telegraph line to Smithville, at the mouth of the river, in order that the cautionary signals may be of greater advantage to the shipping than at present, as all large vessels are compelled to anchor in the harbor there, out of sight of the signals as now displayed. Only four signals have been ordered here during the year, of which number three are reported as having been fully justified.

The station has been twice inspected since last report, once in October, 1871, and again in July, 1872, and found in good condition on both occasions.

Sergeant Robert Seyboth remains in charge, and has rendered all reports, both by mail and telegraph, promptly and in proper form.

The office was injured by fire February 9, 1872, but no report was lost in consequence. The instruments were saved through the exertions of the observer, but the furniture and records were partially destroyed. Private H. Dietz has been on duty as assistant since July 17, and performs his duties satisfactorily.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	30.165	65.9	3.02	East.
	November.....	30.070	55.1	4.46	Northwest.
	December.....	30.200	46.3	3.90	Southwest.
1872..	January.....	30.128	43.5	3.62	North-northwest.
	February.....	29.998	45.9	5.20	North-northeast.
	March.....	30.072	48.8	6.42	Northwest.
	April.....	30.108	63.2	.97	Southwest.
	May.....	30.052	73.2	4.89	Southwest.
	June.....	30.045	78.3	2.87	Southwest.
	July.....	30.056	83.6	5.54	Southwest.
	August.....	30.080	80.8	11.15	Southwest.
	September.....	30.078	75.7	8.22	Southwest.
	Annual mean	30.087	63.4	60.26	Southwest.

NORTH POLAR EXPEDITION.

No intelligence has been received since the date of last annual report from Sergeant Frederick Meyer, the observer with this expedition.

ISLAND OF SAINT PAUL, ALASKA.

[Latitude, 57° 02' ; longitude, 170° 00'.]

Private Charles P. Fish was ordered, March 19, to proceed to San Francisco without delay, and report to Captain Bryant, of the Treasury Department, and accompany him to the island of Saint Paul, in the Aleutian group, for the purpose of making a special series of meteorological observations in that remote locality. Through some misunderstanding on the part of Captain Bryant, that officer left San Francisco before the arrival of the observer, who was compelled to await the departure of the next vessel, sent out by the company having the exclusive control of the trade with the Seal Islands. He left San Francisco April 22, but was unable to get farther than Unalaska, from which island he reports, August 2, that he hopes to complete his journey at an early date.

The following instructions will explain the work to be performed by the observer:

In addition to the ordinary observations taken at every station of the signal service, it is highly important, as also practicable, that at the

island of Saint Paul, in Behring's Sea, the following special observations be made :

1. *Tidal observations.*—These may easily be made by use of the permanent self-registering gauges which have long been in use by the Coast Survey. It is desirable to have two or three of them always in use at differently exposed points along the sea-coast. The mean of these registers will give the approximate heights of the tide, full explanations as to the use of the instrument accompanying it.

2. *The phenomena of storm waves and swells.*—These undulations, which precede a severe gale sometimes two or three days, may be detected on the tide-gauge, after its registration becomes tolerably well known.

In the case of severe and very heavy storms, it will, perhaps, be sometimes possible to hear distinctly the noise of an approaching tempest when it is yet several hundred miles distant, as is often done at the Bermudas. In this inquiry it will be desirable to ascertain, if possible, the side of the island on which the swell first makes itself felt and the direction in which it is translated. This will serve to show the general direction of the storm when moving on southerly parallels.

It will also be of great interest to ascertain the muddy appearance of the water in anchoring depths, as preceding the more violent storms, caused by heavy undulations affecting the bottom of the sea.

3. Keep accurate memoranda of the amount in inches of snow-fall. To ascertain this, it is desirable to select some spot, or, better, two spots, not liable to drifts, and yet not exposed to the wind. Take a small cylinder of glass, and dip or thrust it, with open end down, through the snow, to the ground, which should be previously covered with a piece of plank or some non-conducting material. Melt the snow, and measure the height of the melted snow, in the same glass-cylinder, by inches, multiply the number of inches by 10, and you have the snow-fall.

4. If possible, take the temperature of the sea, surface and submarine and deep sea, between the Aleutian Islands; also northeast and south of Saint Paul's.

5. Preserve notes of any icebergs from the Arctic Ocean that may pass through Behring Strait.

6. Especially is exact and reliable information desired as to any obstructions or ice-bridges closing up Behring Strait in winter, and, if so, all information that may show whether, in that event, the winter temperatures are higher in Alaska and the Aleutian Islands; and also whether, when Behring Strait is blocked up, the current of the Kuro Siwo from being arrested is thrown over upon the American coast with increased velocity, humidity, and warmth.

7. It is desirable also to ascertain the appearance and capture of the sperm-whale within Behring Sea.

8. Notes of all auroral displays.

9. The frequency and types of the electric discharges, lightning, &c., in the vicinity of Saint Paul's.

10. The proportion of fogs to clear weather.

11. It is also desirable to preserve specimens of any camphor-woods, vegetables, sea-weed, coral or sponges that may be picked up upon the coast of Saint Paul's or the Aleutians, and also of all such drift-matter from the Japan, Banin, Loochoo, and other islands of the Pacific.

CANADIAN STATIONS.

MONTREAL.

Telegraphic reports have been made regularly by Dr. Charles Smallwood, in accordance with the arrangement referred to in my last annual report. These reports have usually been sent to Portland, where they were transferred by the observer, with those of his own station, to New York. Weekly reports by mail are also made with regularity, and are filed with those received from other stations.

Meteorological summary.

Year.	Month.	Mean barometer.	Mean thermometer.	Total rainfall.	Prevailing wind.
				<i>Inches.</i>	
1871..	October.....	29.987	50.0	2.443	West.
	November.....	29.906	31.3	8.668	West.
	December.....	29.837	19.2	2.790	West.
1872..	January.....	29.855	19.0	2.136	West.
	February.....	29.876	20.3	2.669	West.
	March.....	29.854	21.2	2.245	West.
	April.....	29.915	44.1	2.440	West.
	May.....	29.882	58.8	1.922	West.
	June.....	29.929	68.7	2.449	West.
	July.....	29.916	71.0	3.182	West.
	August.....	30.008	72.5	3.314	West.
	September.....	29.970	62.0	6.374	West.
	Annual mean....	29.911	44.8	40.632	West.

TORONTO.

Arrangements were made soon after the date of last report with Professor G. T. Kingston, director of the Magnetic Observatory in Toronto, and head of the Dominion Meteorological Bureau, for an exchange of reports as soon as his plans for their collection were elaborated. In accordance with these arrangements, reports from Toronto have been received regularly since November 13, 1871, and from the following-named stations during the periods stated:

Kingston, Began reporting January 2, 1872.
 Port Dover, Suspended reporting February 13, 1872.
 Port Stanley, Resumed reporting July 2, 1872.

Saugeen, { Began reports January 2, 1872.
 { Suspended reports February 13, 1872.
 { Resumed reports July 3, 1872.

Quebec began reporting July 2, 1872.

The observations are made synchronous with those of the stations in the United States, and are sent in the same cipher. They are concentrated at Toronto, and forwarded by Professor Kingston to the observer at Buffalo, who transfers them to Washington. The instruments used are the property of the Dominion, and the observers are under the exclusive direction of Professor Kingston.

The reports have been forwarded regularly, and have proved of great value in reference to meteorological changes on the lakes. At the re-

quest of the Chief Signal-Officer, mail copies of all observations are forwarded weekly, after revision at the Toronto office.

Return reports are furnished from the Buffalo station, as requested by Professor Kingston.

Several of the papers and charts appended to this, afford illustrations of the studies of the observer sergeants. Papers K and L were prepared by Observer-Sergeant Theodore Smith, signal service, United States Army, and papers M and P by Sergeants Schaeffer and Boehmer respectively.

The total number of observer-sergeants on duty at this date is sixty-seven, and of assistant observers, forty-eight.

The charge of stations and reports has remained under the immediate direction of Brevet-Captain H. W. Howgate, United States Army, acting signal-officer and assistant, by whom, as in preceding years, the diverse duties of such a charge, with other duties on occasions of especial service, have been ably conducted.

Since the date of the last annual report, ten additional stations have been established within the United States, and reports are had by a comity of exchange from the seven stations established within the same period in the Dominion of Canada. The total number of stations at which observations are now made, and from which reports are received, is seventy-two. A comprehensive plan for the study of the meteoric conditions of the country has been kept steadily in view in the location of stations. From the stations on the Aleutian Islands and those contemplated in the Sandwich Islands are to be had, it is hoped, the first intimations of storms or meteoric disturbances having their origin, perhaps, on the coasts of Asia, or in the equatorial regions of the Pacific, and destined to extend to the Pacific coasts of the United States. The Pacific coast stations, though few in number, may recognize and report the first appearance on the Pacific coast of the disturbances thus traced, and may enable a connection to be established between their own reports and the reports of the island stations. Eastward of these, the Rocky Mountain stations and the stations upon the great interior plateau, though separated by intervals far too great, keep up a possible connection between the reports had from the Pacific coasts and those coming from the valleys of the Missouri and Mississippi Rivers. It is on this elevated interior some of the most interesting studies are yet to be made. The meteoric conditions of the Missouri Valley connect closely with those of the Mississippi Valley and the country thereto adjacent. The stations located in the valley of the Missouri, together with the stations of the Northwest, those of the Upper Mississippi Valley, and the stations in the immediate vicinity of the Lakes Superior and Michigan, report the first indications of one class of disturbances extending toward the lake region. The stations on the Gulf of Mexico, the Texan stations, and the stations of the Lower Mississippi and of the Ohio Valleys, are located in part to warn against disturbances arising on or traversing the Gulf of Mexico; exhibiting themselves next, perhaps, in the courses of the valleys named and afterward reaching the lakes or extending themselves over the States east of the Mississippi. The stations lying immediately south and north of the lake regions, and those located at the different lake ports, enable care to be had for the commerce of the lakes. Throughout the interior States the meteoric disturbances occurring may be traced from report to report of the stations located within the boundaries of the different States. Passing farther eastward, the eastern and southern stations on the Mexican Gulf receive and give sometimes the first premonitions of storms, which afterward follow the

whole Atlantic coast line northward. The stations located at the Atlantic ports perceive the indications of storms passing eastward of our coasts and at sea, or they are warned, and by their reports warn each other in turn, of the progress of disturbances noted at the stations in the interior or at stations on the Gulf or on the lakes, and which threaten the ports at which they are; and, finally, the Atlantic stations, with the stations of the Saint Lawrence Valley, and those lying within the Northern-Middle, and Eastern States, and upon their coasts, note the last indications of disturbances passing over them, extending yet farther eastward, and out upon the waters of the Atlantic. Sometimes there come afterward reports from the meteoric stations on the coasts of the British Islands, which seem to exhibit the presence there of disturbances thus traced out to sea from our shores. From the first station in the Aleutian Islands, from which reports are considered, to those upon the British coasts, the reports from which are noticed, there intervenes nearly half a circumference of the earth's surface. In all the range of connected and connecting stations, there has not yet been found one the absence of whose reports is not unpleasantly felt. Each accession to their number opens new facts, and brings nearer to certainty the opinions as to the approaching meteoric conditions which those facts indicate.

With the view of diminishing the expenses of the service, and at the same time possessing the power of suddenly increasing the number of stations from which reports are to be had in any section of the country which may at any season of the year be especially threatened by the storms which at the different seasons seem to pass more frequently over particular portions of the territories of the United States, the organization of a mobilized corps of observers has been commenced. This corps, which will consist of picked men, skillful, and chosen for their special fitness for its contemplated duties, will be equipped with portable apparatus, comprising all the instruments they will be required to use at any station to which they may be ordered. The stations to be properly occupied in each section of the country in reference to the storms to which that section is habitually exposed at particular seasons will be designated in advance, and the proper telegraphic connections for these stations will be previously arranged. It will be possible to occupy, in this way, the stations, as stations of report, with very great rapidity. The period of danger for which they may be occupied being passed, they will be abandoned and the force left free to be quickly transferred for the protection of other sections whose seasons of danger may be then approaching.

As the system of life-saving stations extends along the coast, those placed at prominent points will become useful as signal-stations. These stations can be connected by telegraphic wires with this Office, under concurring plans of the Treasury and War Departments, at an expense at most trivial, and with benefits to both services which ought not to be overlooked.

Fifty stations have been thoroughly inspected during the year by officers instructed and detailed for the purpose. The irregularities discovered and corrected demonstrate the necessity of at least two careful inspections of each station in each year. The inspections are yet in progress. (Table 5.) Official applications for the establishment of one hundred and thirteen new stations have been received. (Table 8.) From the detailed report of the operations of each of the established stations, it appears that during the year there have been issued and distributed

at the different lake, sea-coast, and river ports, and in the inland cities, a total number of bulletins, maps, &c., as follows:

Total number of bulletins, (tabulated weather reports,) one hundred and eighty-seven thousand six hundred and seventeen; total number of maps, (exhibiting meteoric conditions,) two hundred and three thousand five hundred and thirty-three; total number of press reports, fifty thousand eight hundred and seventy-eight.

The tri-daily synopses and probabilities have been regularly furnished to the several press associations from the central office at Washington, and through these to the newspaper press throughout the country. The synopses set forth the meteoric conditions, with the changes as reported for the twenty-four hours antecedent to the receipt of each report. The probabilities are the deductions of the Office as to the changes probably to occur within the eight hours (in some instances within the twenty-four hours) then next ensuing. (Paper A'.)

In the year past there have been issued from the central office one thousand and ninety-five of these press reports. The preparation of each report requires the study of the station reports at the hours due, the draughting of a map and the consideration of, at least, the reports and maps received and made within the then current twenty-four hours. Each may be held to represent the results had from the study of an average number of one hundred and fifty meteoric reports. A total number of one hundred and thirty-six thousand five hundred reports of observations have been in this way discussed during the year. The wide diffusion given these reports by the relations established by the office with the press is evidenced by the fact that it is estimated, computing the number of copies published at each edition of each newspaper in which reports or bulletins have appeared, that the aggregate number of copies of the reports furnished from this Office which have been laid before the public has reached a total of thirty millions. This extensive publication has been without cost to the United States.

It has been the policy of the Office to enlist, by this wide diffusion of its reports, the services of the thousands having some knowledge of meteorology, and possessing local instruments, in the work of supplementing the Office reports, by their local knowledge and the use of their own observations to the end of correctly interpreting, each for his own location, what the Bureau might be able to foreshadow only for a whole section of territory. To render this practice habitual is of the greatest importance. The usage once established will of itself notably diminish the number of disasters by shipwreck. It will be of important advantage to all interests of agriculture. There is hardly a vocation which will not find in it its uses.

The lateness of the hour at which the night telegraphic reports are received has rendered it sometimes impossible to furnish the official deductions from the reports in time to be telegraphed east and west from New York, to reach the various cities in the northern and western portions of the United States before the morning papers have been sent to press. This difficulty has led to a change in the time of making and transmitting the night report from the hour of 11.35 p. m. to that of 11 p. m., Washington mean time. This change was made on September 1st of this year.

It is for every reason desirable that each publication of reports in any newspaper should be of the report last issued from this Office prior to the time at which the paper goes to press. The mode by which to attain this end is yet a subject for study and experiment.

Professor Cleveland Abbe, assistant, First Lieutenant Robert Craig,

acting signal-officer and assistant, and Professor Thompson B. Maury, assistant, have alternated in preparing the official deductions of the Office, besides performing such other duties in connection with the reductions of observations as have been found desirable.

The favorable expression of scientific men, the popular credit given the publications of the Office, and the surprise and almost irritation exhibited if at any time they chance to be in error, as must sometimes happen, have sufficiently evidenced the skill and care these officers have manifested in the discharge of their duties.

A comparison of the tri-daily forecasts, or "probabilities," as they have been styled, with the meteoric condition afterward reported, so far as known, has given an average of 69 per cent., as verified up to November 1, 1871. Since that date to the present time (October 1, 1872) the average of verification has been 76.8 per cent. If regard be had to those predictions verified within a few hours after the time for which they were made, this percentage is considerably increased, there being a total percentage of verifications and partial verifications of 82 per cent. Those predictions considered verified are, however, the only ones to be properly estimated upon. In view of the deficiency of telegraphic facilities during the year, and the great irregularities of the working, it was not anticipated that these predictions, based as they are upon the tri-daily telegraphic reports, would increase in accuracy. Whatever success has been attained must be considered an indication of what success might be with well-organized and full telegraphic facilities. The difficulty of telegraphic communication with the stations was greatest, and was most seriously felt during the months of July and August. It then not unfrequently happened that the most important and widespread of the press probabilities—*i. e.*, those drawn at midnight from the midnight reports—were made in the absence of any current telegraphic information at that hour due from the observers west or south of the Alleghanies. It is on this section the Office is most dependent for the intelligence which suggests the meteoric changes impending in the Eastern, Middle, and Southern States, and upon the Lakes.

Three hundred and fifty-four cautionary signal-orders have been issued during the year, each display of the cautionary signal at any station being considered a separate order. This signal was announced as to be shown "whenever the winds are expected to be as strong as twenty-five miles an hour, and to continue so for several hours, within a radius of one hundred miles from the station."

The percentage of cautionary signals, verified by the occurrence of the winds described within a few hours after the display of the signal, either at the port at which the signal was exhibited, or within the radius of one hundred miles from that port, is estimated to have been about 70 per cent. The instances of signals displayed, reported not verified, are those in which they have not been proven necessary at the station where exhibited. The signal is wholly "cautionary," forewarning probable danger. It has been aimed to err on the side of caution. The delays such errors may cause are retrievable, the disasters of shipwreck are not. Since the 1st of July of the present year thirty-two cautionary signals, forewarning the approach of six different storms, have been displayed at different ports. Of these storms five were destructive, justifying the display of twenty-eight signals; one, in advance of which four signals were displayed, was not considered dangerous. It is not yet permitted to hope this accuracy can be maintained.

It must not be imagined that in the review of the year there are not found errors of omission, or that warnings have been given in all

instances of danger. Local storms of narrow extent, or making their march in a few hours, may pass between stations or over too few only, and are not easily traceable.

The practical results of this branch of the service, with all its errors and imperfections, can be summed, it is believed, in the statement that since the inauguration of its duties no great and continuous storm has traversed the territory of the United States, or raged along the length of its lakes, its gulf or sea-coast shores, as in their course such storms have sometimes done, without fair and general premonition given at the great majority of the points endangered, to any who cared to seek or heed them.

The storms of October 31 and November 1; 9th, 10th, and 11th; 13th and 14th; 18th and 19th; 24th; 29th and 30th; December 5, 6, 7, and 8; 10th; 15th and 16th; 16th; 20th; 23d; 30th and 31st, 1871; and February 3; 8th and 9th; 13th and 14th; March 1 and 2; 4th; 18th; April 11; 15th; 24th; 30th; September 24th and 25th; 28th and 29th, 1872, are mentioned as instances of those in advance of which notification has been given.

Papers J, K, and L, with the appended charts and descriptions of the storms of November 11 to 16, 1871, March 1 and 2, 1872, and September 28 to 30, 1872, are illustrations of the manner in which storms may be traced from the reports had at the Office.

Improving accuracy in the announcement of the approach and force of storms may be expected to follow longer experience. It will increase with each wise increase in the number of stations and reports. There is essential need of such control of telegraphic facilities as will insure the prompt receipt of these reports at any moment they may be called for.

Soon after the date of the last annual report, arrangements were made with Professor G. T. Kingston, of Toronto, chief of the Dominion meteorological bureau, in compliance with an official request from that bureau, and in view of a considerable appropriation contemplated by the Dominion of Canada for the purpose of a system of observation and report similar to that existing in the United States, for an exchange of reports with his office as rapidly as the system may extend in the Dominion. In accordance with these arrangements telegraphic reports are now received from seven Canadian stations. The observations are made synchronous with those in the United States, and are worded in the same cipher. These reports have been forwarded regularly to this Office after concentration at Toronto, and have proved of value in connection with the lake region. Separate reports are furnished from Montreal by Professor Charles Smallwood, director of the Montreal Observatory. Returned reports are furnished by this Office, as requested, to both Toronto and Montreal. Warnings, announcing probable meteoric changes, and prepared with especial reference to the Canadian ports, are sent to Toronto whenever any serious disturbance is indicated. A notable instance of this co-operation was had in the progress of the great storm of September 28, 29, and 30 of this year. Warnings were given in advance at the lake ports of the United States, and similar warnings were at the same time telegraphed to Canada. The advantages resulting to both states from this arrangement are highly estimated. Aside from the sentiment of international comity and good will, incident to its existence, it is of practical value. To the Dominion, located as it is, the exchanged reports received from the United States are essential to safety. To the United States the reports received from the Dominion are like those of vidette stations against the storms moving upon the

lake region from the north, and thence traversing the Northern, Middle, and Eastern States, and the adjacent sea-coast. The appropriation made by each nationality, without in any way lessening its value to the people who make it, is in effect supplemented by the sums similarly devoted by the other, a mutual benefit accruing to both. It is to be hoped the system may be extended in the Canadas, and the co-operation be yet closer, this connection of the services becoming the first link in the grand chain of interchanged international telegraphic reports, destined with a higher civilization to bind together the signal-services of the world.

Arrangements of a similar description are contemplated as to be made for the exchange of observations by telegraph with various points in the West India Islands, as soon as the authorization of the different governments interested can be had. These arrangements will be carried into effect, if possible, before the opening of the stormy spring season.

It is believed that many of the cyclonic storms, the indications of which are first felt by the stations of the United States, as then showing the disturbance upon the Gulf of Mexico or near the Atlantic coast, and which storms are afterward to be traced across the States intervening, to the lakes, or along the Atlantic sea-coast, pass in their course over places in these islands from whence their presence could be pre-announced. The returning reports from the United States to the West India ports might indicate dangers threatening near the sea-coasts of the United States, or disturbances upon the Gulf westward of those islands, of which their commerce should be warned.

A reference to international exchanges of this character was made in the last annual report of this Office. They are entirely practicable, useful, and cannot be too widely extended.

Since January 1, 1872, statements of the changes in the depths of water in the principal western rivers, being in direct relation to the meteoric changes, have been reported daily from all stations established upon those rivers. These reports are carefully prepared, and have been received with a marked degree of interest. Numerous applications for additional reports and stations are under consideration. The importance of the information thus conveyed to the commercial interests of the river and inland cities has been fully recognized by the local presses and the river population. It is hoped that as the number of stations increases, and communication with the proper authorities is organized, a portion of the great problem of the protection of the river commerce from ice and freshets, and of the lower river levees from breakage and overflow, with the consequent disasters, will be solved, as they certainly can be, by timely warnings which will be given.

By the act of Congress approved June 10, 1872, the duty was imposed upon the Secretary of War of providing such stations, signals, and reports as might be found necessary for "the benefit of agricultural and commercial interests" throughout the United States. The service before technically limited to the lakes and sea-coasts was thus extended throughout the interior. The agricultural societies in the United States, the addresses of whose officers could be obtained, were informed in July last of this fact, and each was requested to appoint a permanent committee to confer from time to time with the Chief Signal-Officer, and to take in conjunction with him such steps, or to recommend such action, as might be deemed desirable to accomplish the objects in view. Eighty-nine societies have appointed committees in compliance with this request, and notice has been given by a large number of other societies that similar action will be taken by them at an early date. (Table IX.)

While the agricultural interests have shared with others whatever benefit has followed the daily published reports of the Office, and care has been had for those interests in the preparation of the reports, the plans by which it was contemplated to extend a service especially beneficial to those interests have been in some degree delayed by the want of telegraphic and other facilities by which to reach the interior. There has not yet been time in which to fairly organize the details of operations. The field for duty is a large one, and the service in it must be slowly established. But it is believed that with the daily reports and notice of the signals of the Office, or its connected stations, disseminated as they are by the press and channels now in use or known, some simple instructions as to the general courses or probable sequences of meteoric changes on this continent, and one or two inexpensive instruments and plain directions for using them, alone or in connection with the reports, results of important benefit can be obtained. The apparatus can be so cheaply furnished, and its indications be made so simple, that the whole can be had and used anywhere by any intelligent man.

In addition to the committees of the agricultural associations above referred to, thirty-eight boards of trades and chambers of commerce of principal cities and ports have standing meteorological committees which are in direct communication with the Chief Signal-Officer. (Table X.) To all of these committees printed summaries of the meteoric changes for the week then past are, by direction of the Secretary of War, mailed from the office of the Chief Signal-Officer, upon Saturday of each week, for the use of the associations. (Paper Z.)

This paper is an abstract made from the daily telegraphic reports in the form of a general summary of the synopses for the week. It is improved from time to time by the addition of such data as it may be in the power of the Office to give, and which are suggested as desirable by the associations, or known to be of general utility. In addition to the copies furnished the associations, copies are furnished the presses having the largest interior circulation. This paper has been favorably received.

The great railway enterprises, with their vast extent of roads, have an immediate and daily interest in the meteoric conditions existing in the sections traversed by their tracks, or by those of connecting companies. It is in the contemplation of the Office to furnish, if it is found feasible to do so, by arrangement with the companies, whatever information it may be in its power to give, directly beneficial to their interests.

The meteoric conditions throughout the United States for each day of the year past have been traced on one thousand and ninety-five separate maps, one being traced for each interval (average) of eight hours of time. The form of map has been much improved, the base map now exhibiting an orographic representation of the United States and of the adjacent territory from which reports are had. In the preparation of the map the orographic charts prepared by Professor A. Guyot, of Princeton, were used, the information had from them being supplemented by the use of whatever data could be elsewhere collected by the Office. Each map exhibits in its meteoric features the results had from a consideration of an average number of three hundred and fifty separate readings of different instruments at seventy-two stations. These readings are of especial value as being made from similar instruments, each of which has been compared with the same standard. (Papers W, X, and Y.)

In March last the Office publication of a collection of the tabulated reports and synopses, together with the official deductions, or forecasts,

and a statement of the meteoric conditions occurring after the latter, the whole in book form, was commenced. This paper has been continued up to this date, and is intended to form the basis of a monthly issue to contain, in addition to the above matter, reduced copies of each of the tri-daily maps above referred to. The record is perhaps not paralleled by that had in any other country.

The courses of the areas of low barometer have been traced on especial maps, by months, from March, 1871, to June, 1872, inclusive, and tables are prepared giving the minimum readings, with latitude and longitude, at intervals of eight hours during the movement of any area within the scope of the stations of observation. Illustrations of these maps are given in Plates U and V, herewith. Some of the areas of low barometer have apparently traversed the entire continent, from the Pacific to the Atlantic; some have passed over a portion of the States, while others have made their first appearance in the Gulf of Mexico, moving thence over Eastern Texas, and following the river valleys to the lower lakes. A great number of these storm-centers have passed over the lake region.

The following gives the lowest observed readings of the low barometers, with the number of areas traced for each month, from March, 1871, to June, 1872, inclusive:

March, 1871,	twelve areas of low barometer, varying from.....	29.80 to 29.00.
April, 1871,	nine areas of low barometer, varying from.....	29.80 to 29.44.
May, 1871,	six areas of low barometer, varying from.....	29.60 to 29.30.
June, 1871,	twelve areas of low barometer, varying from.....	29.70 to 29.40.
July, 1871,	twelve areas of low barometer, varying from.....	29.85 to 29.50.
Aug., 1871,	twelve areas of low barometer, varying from.....	29.79 to 29.20.
Sept., 1871,	thirteen areas of low barometer, varying from.....	29.80 to 29.45.
Oct., 1871,	thirteen areas of low barometer, varying from.....	29.69 to 29.20.
Nov., 1871,	twelve areas of low barometer, varying from.....	29.85 to 29.10.
Dec., 1871,	thirteen areas of low barometer, varying from.....	29.70 to 29.10.
Jan., 1872,	nine areas of low barometer, varying from.....	29.85 to 29.26.
Feb., 1872,	thirteen areas of low barometer, varying from.....	29.70 to 29.40.
March, 1872,	eighteen areas of low barometer, varying from.....	29.87 to 29.15.
April, 1872,	ten areas of low barometer, varying from.....	29.80 to 29.00.
May, 1872,	nine areas of low barometer, varying from.....	29.84 to 29.26.
June, 1872,	six areas of low barometer, varying from.....	29.79 to 29.20.

The locations of the areas of high barometer have also been mapped for the same period of time, but while a few are traced directly across the continent, the majority give tracings without apparent regularity.

A large amount of office-work has been devoted to collating and discussing the observations received from all stations and collected from other sources, public and private, with a view to their ultimate publication in permanent form. The Office has received many very courteous tenders from public institutions and from private individuals offering the use of material collected by them or in their charge.

Attention has continued to be given to the subject of the reduction of the barometric readings (observations) had at great altitudes to the hypothetical readings at sea-level. A series of tables for this purpose, in course of preparation by Assistant Abbe, has been delayed by the illness of that officer.

A serious obstacle to the accurate reduction of meteorological observations has been found in the want of the proper information in regard to the elevations above sea-level of the different instruments at the several stations. To remove this difficulty, the work of collecting reliable *data* from surveys and other official sources was commenced in February last, and has been vigorously prosecuted since by Lieutenant Henry Jackson, acting signal-officer and assistant. This collection is

still in progress. The following statement exhibits the material collected up to this time, and which has been carefully tabulated and corrected for future publication as well as for immediate use.

Number of levels of railroad lines collected from records in the topographical office of the Post-Office Department, 308.

Number of levels of canals collected from records in the same office, 14.

Number of levels of railroad lines collected in the office of the Chief Signal-Officer from railroad companies, 256.

Number of levels of western surveys collected from the records of the Interior Department, 12.

Number of levels of railroad surveys collected from the records of the Interior Department, 7.

Number of levels received from city engineers, being connections between different railroads in the respective cities, 46.

Number of complete lists of State surveys received from State engineers, 43.

Number of surveys of rivers and lakes received from United States Engineer Department, 7.

In addition to the above the United States Coast Survey has furnished a table showing the height and range of the tide at all important ports on the coast of the United States. For assistance rendered in this connection the Office is under obligations to Professor W. L. Nicholson, topographer of the Post-Office Department; to Professor C. S. Peirce, assistant in charge of the United States Coast Survey Office; to the Commissioner of the Land-Office in the Interior Department; to the Chief of Engineers, United States Army; to the officers of the various railroad companies throughout the United States, and to the city engineers of most of our important cities.

Some attention has been given to the investigation of the meteoric conditions at different elevations. A series of especial observations were made simultaneously on the summit and at the base of Mount Washington, in May last, for this purpose.

The experiment of a balloon ascension has been tried with fair results. The ascension was made by contract had with a professional aeronaut, and had in view the determination of the question whether the proper instruments could be carried and used with needful accuracy, an observer-sergeant being charged with the duty. One hundred and fifty-six readings were made during the ascension. This experiment is thought to have established that very delicate instruments may be employed hereafter, if it is considered desirable.

Reference was made in the last annual report to the utility of observations had in the upper aerial currents, in relation to some of the *data* of practical meteorology. The station at the summit of Mount Washington, at an elevation of 6,290 feet above the sea, has been maintained since December 15, 1870. From that date tri-daily telegraphic reports have been had from the party there stationed. It is desirable that new mountain-stations should be established and suitably provided along the Apalachian chain and in the Rocky Mountains. These, together with certain special stations on the western plains, should be provided with self-registering apparatus.

To extend the system of synchroal observations, blanks have been furnished to such ship-captains and others making voyages to sea as have signified their willingness to make the necessary observations at the stated times. Facilities are given for comparing the instruments

used upon the vessels with the standard at Washington. Fifty-two records have been received from the Pacific Mail Steamship Company.

These records have been valuable in tracing the courses of atmospheric disturbances before they reach the coasts of the United States, or after they have passed from the coasts seaward. Similar assistance is invited from all ship-owners and those interested in commerce.

The study and comparison of the best known meteoric instruments, for the purpose of ultimately securing the greatest advantages in the standard instruments to be constructed for the United States, has continued since the date of last report. The collection already in possession of this Office has become interesting and valuable. The equipment of the stations throughout the country with reliable apparatus is of the first importance. An electric attachment to the Robinson anemometer, furnishing a continuous record of the velocity of the wind, devised for the office by Lieutenant D. J. Gibbon, acting signal-officer, has been tested and adopted for all the stations. Experiments are in progress to determine the structures of a water-gauge, wind-vane, and of other instruments, to be also self-registering by electricity. It is requisite that they be strong, reliable, and inexpensive. The electric record permits the working portion of the apparatus to be exposed wherever may be best for its uses. The record alone is had in the office of the observer. The self-registering instruments to which reference has been made in previous reports, are now more favorably placed in a room especially fitted for them.

The Department has been again indebted to the Post-Office Department, which, under the especial order of the Postmaster General, has continued the service of transporting, in care of its mail-agents, the barometers and other delicate instruments needed to supply the places of those rendered useless by accident at the stations.

The library of the Office has been increased from six hundred volumes to one thousand three hundred and forty. These books have been catalogued and arranged conveniently for reference, and form the nucleus of a valuable meteorological library, to which additions may be made from time to time.

A system of exchanges with foreign societies has been instituted during the year, and on the part of this Office over five hundred sets of the tri-daily weather maps and bulletins have been sent abroad.

The full daily issue has been sent regularly to the following parties, and has been suitably acknowledged: Robert Scott, esq., director of the London Meteorological Society; Professor Buys Ballot, director of the Royal Meteorological Institute of the Netherlands; Professor H. Mohn, director of the Meteorological Institute of Norway; Captain N. Hoffmeyer, director of the Danish Meteorological Institute; Professor Dr. Prestel, Emden, East Friesland, Germany; Imperial Naval School, Kiel, Germany, furnished through the German legation in this city.

Some idea of the extensive labor devolving upon the Office from its now wide-spread connections may be had from the consideration of the number of papers requiring its action, the record showing thirty-five thousand nine hundred and ninety letters sent, and one hundred and seventy-three thousand three hundred and six letters received during the year. Three thousand one hundred and sixty-five accounts have been examined and settled in the property division. (Table 6.)

Brevet Lieutenant-Colonel Garrick Mallery, acting signal-officer and assistant has had charge of the records, general correspondence, and orders; Lieutenant Henry Jackson, acting signal-officer and assistant,

has been in charge of the property division. The untiring zeal of these officers has entitled them to especial commendation.

The office sustained a serious loss by the death, on December 24, 1871, of Brevet Major L. B. Norton, assistant signal-officer, for many years property and disbursing officer of the signal-service. He served with gallantry during the war, and zealously, until the time of his death, a continuous service on signal duty of more than ten years' duration.

The telegraphic transmission of reports of observations was had over the lines of the Western Union Telegraph Company, in accordance with the plans and working forms of circuit of this Office, substantially as exhibited in the last annual report, until June 30 of the present year, when that company declined to continue the service on terms considered satisfactory by the officers of the United States. From June 30 to July 21 it was attempted to conduct the service upon plans differing from the systems of working forms of circuits originally devised for it. The delays, however, proved to be so great, even in what were recognized as the business hours of the companies, and, despite the orders of the presidents of the several companies that the reports should be given priority over all other business, that very many of the reports, when received, were useless. The Office was compelled to resume the form of systematized working circuits as soon as it became practicable to do so. Since July 21 the reports have been had over the wires of the Franklin, Atlantic and Pacific, Southern and Atlantic, Pacific and Atlantic, Great Western, and Northwestern and International Ocean Telegraph Companies, which have consented to transmit the official dispatches to the extent their combined facilities permitted, and in accordance with the working forms of circuits furnished by this Office. Papers T¹ to T¹³ exhibit the working forms of circuits adopted. Some difficulty was experienced in making the proper connections of these circuits, involving, as they did, the wires of so many distinct companies, and the service suffered from serious delays in consequence. The difficulties in the way of successful working are being gradually removed. The subject of its telegraphic communications has been one of the most delicate with which the Office has had to do—duties wholly dependent for their success upon the rapidity and reliability of its telegraphic connections, and with responsibilities involving often the lives, as well as property, of those who might look to it for warnings, there is none which could more properly excite anxiety. Very many questions affecting the relations of the United States and the different telegraph companies have never been settled by precedent or usage. In the correspondence and action which have been had during the year with the different companies upon matters on which there were disagreeing views it has been the aim of this Office, under the direction of the Department, to maintain such a position that each company might feel it had been treated with equal justice, however much the Department might necessarily differ from any of them in its views.

A certain official commendation and good-will seems to be due to those companies which have evidenced their willingness to lend their aid in carrying on the service, trusting all questions to future satisfactory settlement. The rates of compensation the Office has felt empowered to offer being made in some instances a cause of complaint, the Office has stated to any company so complaining that if, upon a just statement of the cost of the service and its proper value to the companies, it cannot be found to be fairly remunerative, the officers of the Department will willingly join the representatives of the companies in

the presentation of the facts to Congress or other authority, with the view of securing to the company just compensation.

To secure the discharge of the telegraphic duties of the Office with promptness—with the good will and co-operation of whatever companies might be carrying its service, and with proper remuneration allowed to them for that service—have been the ends to be attained. As the relations of the people of the United States to the telegraphic companies having privileges under the acts of Congress become better determined, and the style of the official communications the Executive Departments may be permitted to have over the wires of the companies, the times at which they are authorized to require the transmission of such communications, and the rates of payment at which the communications transmitted must be paid for, become established, the difficulties which at the outset have hampered this service will disappear.

The Department has been fortunate in the constant advice of the Hon. William Whiting, special assistant of the Attorney-General, in reference to questions of the duties of the telegraphic companies.

The telegraphic service in the Office has been under the immediate charge of Mr. George C. Maynard, electrician, who has rendered important and special service. During the year ended September 30, 1872, seven hundred and sixty-eight thousand and forty-six words of weather reports have been received at, and eighteen thousand seven hundred and forty-two words sent from this Office. One thousand nine hundred and forty-four messages other than reports, but on business connected therewith, were also sent from, and two thousand one hundred and eighty messages received at this office. One hundred and thirty-four thousand three hundred and eight mail reports have been examined and compared with the telegraphic copies and filed for future reference.

The numerical cipher used for the transmission of the reports at date of last report was replaced on the 1st of January by one of a different form. (Paper C.)

By the use of this cipher the number of words have been reduced one third, while the amount of information contained in each report has been increased.

In view of the large and constantly increasing labor of the Office, the compensation of the clerks of class two, employed in it and having general charge of its clerical duties, is considered inadequate. It is recommended that to secure to them a just promotion, the employment of two clerks of class four be authorized.

The propriety of an established organization of the officers of the signal service becomes more apparent as their duties increase in extent and importance. Separated from the commands to which they belong, and on a duty differing from the routine duties of those commands, they lose familiarity with that routine, and by absence from their regiments incur the displeasure of their commanding officers, who do not always reflect that such absence is not voluntary, but in obedience to orders from proper authority. The officers themselves cannot feel while on a detached service that interest in their duties which is felt when promotion and standing is to be obtained by the display of such interest. They are liable to be detached at any time and returned to their regiments. It seems just to both officers and enlisted men that they should be given a recognized organization. The attention of the Secretary of War is especially invited to this subject.

The recommendation that an appointment to a commission be given

each year to that observer sergeant who shall in that year be reported as most distinguished for fidelity and ability is renewed.

The promotion to the grade of second lieutenant of Observer Sergeant D. J. Gibbon last year, recommended for his appointment upon such grounds, has been productive of good effects.

At the end of another year of service, during which the active labors of the Office and its connected stations have ceased on no day or night, the annual report, with its record of duty done, is submitted with satisfaction. In no year to come is it likely the service can be more embarrassed than it has been in the year just passed with the difficulties to be encountered by a novel service. It has survived them. The encouragement had in the popular good will and interest in the daily duties, the support of the press and of the different commercial and agricultural associations, has been continued. The public criticism has been considerate. The scientific institutions throughout the United States have received the exchanges of the Office with pleasure and have rendered assistance whenever in their power. From those of almost every foreign country are had expressions of interest and suggestions of co-operation. The field for study and improvement, under a higher guidance, extends with each day's experience. The possible public good to be had, with the service properly conducted and sustained, and with facilities now proved to be attainable on this continent, cannot be estimated.

ALBERT J. MYER,

Brigadier-General and Chief Signal-Officer of the Army.

Hon. W. W. BELKNAP,
Secretary of War.

RECORD OF SIGNAL CAMP OF INSTRUCTION, FORT WHIPPLE, VIRGINIA.

TABLE I.—*Officers instructed during the year ending October 1, 1872.*

Name.	Rank and corps.	Reported for instruction.	Relieved from instruction.	Remarks.
Charles S. Smith.....	First lieutenant Fourth United States Artillery.	July 13, 1871	Nov. 25, 1871	Completed full course in signaling, telegraphy, and meteorology.
H. H. Humphreys....	First lieutenant Fifteenth United States Infantry.	Aug. 18, 1871	Dec. 7, 1871	Do.
Charles E. Kilbourne.	First lieutenant Second United States Artillery.	Sept. 19, 1871	Dec. 18, 1871	Do.
Lewis Warrington...	First lieutenant Fourth United States Cavalry.	Feb. 2, 1872	Mar. 9, 1872	Relieved before completing full course of instruction.
H. H. C. Dunwoody...	First lieutenant Fourth United States Artillery.	Mar. 4, 1872	Aug. 1, 1872	Reported originally July 10, 1871; granted leave of absence July 12, 1871, to Mar. 3, 1872.
David J. Gibbon.....	Second lieutenant Ninth United States Cavalry.	.....	.....	Still under instruction.

TABLE II.—Amount of field-practice had by each officer.

Name.	Rank and corps.	No. of days flag-practice was had.	No. of nights torch-practice was had.	Remarks.
Charles S. Smith	First lieutenant Fourth United States Artillery.	12	1	
H. H. Humphreys	First lieutenant Fifteenth United States Infantry.	16	2	
Charles E. Kilbourne	First lieutenant Second United States Artillery.	16	2	
Lewis Warrington	First lieutenant Fourth United States Cavalry.			Study of manual of signals, wand-practice, &c., for 22 days.
H. H. C. Dunwoody	First lieutenant Fourth United States Artillery.	10	2	
David J. Gibbon	Second lieutenant Ninth United States Cavalry.			Still under instruction.

TABLE III.—Number of observer-sergeants instructed from October 1, 1871, to September 30, 1872.

Name.	Instruction commenced.	Date of examination.	Remarks.
Hugh Coyle	June 17, 1871	Nov. 6, 1871	Promoted to rank of sergeant November 6, 1871; in charge of station at Shreveport, La.
N. D. Lane	Aug. 12, 1871	Oct. 6, 1871	In charge of station at Augusta, Ga.
E. O. C. MacInerney	Aug. 18, 1871	Feb. 23, 1872	Promoted to rank of sergeant February 23, 1872; in charge of station at Galveston, Texas.
F. Mansfield	Aug. 18, 1871	Oct. 6, 1871	In charge of station at New Orleans, La.
J. B. Wells	Aug. 18, 1871	Oct. 6, 1871	In charge of station at San Diego, Cal.
George McDonald	Aug. 18, 1871	Oct. 6, 1871	Awaiting orders at Fort Whipple, Va.
A. J. Tilley	Aug. 19, 1871	.....	Failed to pass final examination.
F. Mann	Aug. 24, 1871	Oct. 13, 1871	In charge of station at Detroit, Mich.
Charles E. Wheeler	Aug. 25, 1871	Oct. 13, 1871	Dishonorably discharged the service.
M. J. Shanefelter	Sept. 8, 1871	Oct. 20, 1871	In charge of station at Key West, Fla.
A. B. Knight	Sept. 8, 1871	Oct. 20, 1871	In charge of station at Virginia City, M. T.
D. O'Donoghue	Sept. 13, 1871	Oct. 20, 1871	In charge of station at Mobile, Ala.
F. P. Bayes	Sept. 14, 1871	Aug. 20, 1872	In charge of station at Alpena, Mich.
John P. Clum	Sept. 18, 1871	Oct. 20, 1871	In charge of station at Santa Fe, N. M.
Gustave A. Dandeleit	Nov. 10, 1871	Mar. 19, 1872	Promoted to rank of sergeant March 19, 1872.
J. O. Manson	Dec. 2, 1871	Jan. 5, 1872	In charge of station at Savannah, Ga.
George Prender	Jan. 15, 1872	Mar. 8, 1872	In charge of station at Fort Sully, D. T.
Charles Lever	Feb. 13, 1872	.....	Discharged before passing examination.
E. F. Maynard	Aug. 4, 1871	Apr. 1, 1872	Instructed on station; in charge of station at Cincinnati, Ohio.
Edward Lloyd	Feb. 10, 1872	Apr. 10, 1872	In charge of station at Indianola, Texas.
Charles A. Shaw	Jan. 20, 1872	Mar. 8, 1872	In charge of station at Breckencridge, Minn.
Richard Williams	Mar. 15, 1872	July 11, 1872	Reduced to the ranks for misconduct; now on duty with the detachment at Fort Whipple, Va.
Leslie C. Fletcher	Apr. 1, 1872	May 31, 1872	On duty at the office of the Chief Signal-Officer.
Samuel W. Beall	Apr. 10, 1872	May 31, 1872	In charge of station at Corinne, U. T.
Max Marx	Apr. 10, 1872	May 31, 1872	In charge of station at Davenport, Iowa.
John Dascomb	Apr. 19, 1872	May 31, 1872	In charge of station at Du Luth, Minn.
James O'Dowd	Apr. 22, 1872	July 11, 1872	In charge of station at Lake City, Fla.
W. S. Jewell	May 17, 1872	July 11, 1872	On duty at office of the Chief Signal-Officer.
George A. Clum	May 17, 1872	July 11, 1872	In charge of station at Montgomery, Ala.
William T. Boyd	June 17, 1872	Aug. 21, 1872	In charge of station at Philadelphia, Pa.
Harry Barton	June 17, 1872	Aug. 21, 1872	In charge of station at Omaha, Neb.
Thorpe B. Jennings	June 17, 1872	Aug. 23, 1872	On duty at the office of the Chief Signal-Officer.
David H. Sackett	June 17, 1872	Aug. 23, 1872	In charge of station at Milwaukee, Wis.
William Lise	June 17, 1872	Aug. 23, 1872	On station at Mount Washington, N. H.
Robert J. Bell	June 17, 1872	Aug. 23, 1872	In charge of station at Escanaba, Mich.
William Theodovius	July 9, 1872	Aug. 23, 1872	In charge of station at Punta Rasa, Fla.
Nelson Gorom	Aug. 21, 1872	.....	Still under instruction.

TABLE IV.—*Number of enlisted men instructed for the position of assistant to observer-sergeants from October 1, 1871, to September 30, 1872.*

Name.	Placed under instruction for assistant.	Reported qualified as assistant.	Ordered on station.	Remarks.
William Black.....	Oct. 23, 1871	.....	Oct. 23, 1871	Ordered to Fort Whipple, Virginia, for promotion.
E. S. Martin.....	Jan. 23, 1872	.....	Feb. 1, 1872	At Fort Whipple, Virginia, awaiting orders.
Otto Schütze.....	June 10, 1872	June 27, 1872	July 9, 1872	On duty as assistant at Baltimore, Maryland.
Thomas A. Taylor.....	Jan. 22, 1872	Feb. 10, 1872	Feb. 16, 1872	On duty as assistant at Buffalo, New York.
Timothy O'Neil.....	Jan. 25, 1872	Feb. 10, 1872	Feb. 10, 1872	Ordered to Fort Whipple, Virginia, for promotion.
James H. Marsh.....	Nov. 3, 1871	.....	Nov. 3, 1871	Do. do.
Daniel Murphy.....	Feb. 6, 1871	.....	Feb. 6, 1871	On duty as assistant at Indianapolis, Indiana.
William Stein.....	Jan. 3, 1872	.....	Jan. 3, 1872	Ordered to Fort Whipple, Virginia, under arrest.
C. A. Brogan.....	Feb. 10, 1872	.....	Feb. 10, 1872	Ordered to Fort Whipple, Virginia, for misconduct.
Charles P. Fish.....	Feb. 12, 1872	Feb. 12, 1872	Feb. 12, 1872	In charge of station at Island of Saint Paul, Alaska.
A. F. McDermott.....	Mar. 4, 1872	.....	Mar. 15, 1872	On duty at office of the Chief Signal-Officer.
Edward Moran.....	Mar. 4, 1872	Mar. 15, 1872	Mar. 15, 1872	On duty as assistant at Cleveland, Ohio.
Thomas G. White.....	Mar. 4, 1872	Mar. 15, 1872	Mar. 26, 1872	Ordered to Fort Whipple, Virginia, for promotion.
W. H. Colesberry.....	Mar. 5, 1872	Mar. 16, 1872	Mar. 19, 1872	On duty as assistant at Toledo, Ohio.
Joseph E. Cook.....	Mar. 9, 1872	.....	Mar. 26, 1872	On duty as assistant at Galveston, Texas.
W. C. W. Shreck.....	Mar. 15, 1872	Mar. 27, 1872	April 1, 1872	On duty as assistant at Nashville, Tennessee.
L. E. Seabee.....	Mar. 15, 1872	Mar. 27, 1872	May 20, 1872	On station-duty at office of the Chief Signal-Officer.
F. Z. Gosewisch.....	Mar. 15, 1872	Mar. 27, 1872	April 8, 1872	On duty as assistant at Chicago, Illinois.
Henry U. Jones.....	Mar. 20, 1872	April 1, 1872	Apr. 10, 1872	On duty as assistant at Lake City, Florida.
R. McLaughlin.....	Mar. 22, 1872	April 6, 1872	Apr. 10, 1872	On duty as assistant at Vicksburgh, Mississippi.
William C. Keech.....	Mar. 25, 1872	.....	Apr. 8, 1872	On duty at office of the Chief Signal-Officer.
W. Stromberger.....	Mar. 29, 1872	Apr. 13, 1872	Apr. 15, 1872	On duty as assistant at Detroit, Michigan.
Sidney Powell.....	Mar. 29, 1872	Apr. 13, 1872	Apr. 22, 1872	On duty as assistant at Charleston, South Carolina.
A. D. Wolcott.....	Mar. 29, 1872	Apr. 13, 1872	May 2, 1872	Ordered to Fort Whipple, Virginia, awaiting orders.
W. A. Chapman.....	Apr. 6, 1872	Apr. 26, 1872	May 7, 1872	On duty as assistant at Key West, Florida.
Arthur W. Hart.....	Apr. 6, 1872	Apr. 26, 1872	May 2, 1872	Ordered to Fort Whipple, Virginia, for misconduct.
James H. Stockwell.....	Apr. 6, 1872	Apr. 26, 1872	May 17, 1872	Do.
John Laurens.....	Apr. 5, 1872	.....	.....	On duty at office of the Chief Signal-Officer.
E. W. McGann.....	Apr. 19, 1872	May 17, 1872	May 17, 1872	On duty as assistant at Leavenworth, Kansas.
John W. Everly.....	Apr. 26, 1872	May 28, 1872	.....	Awaiting orders at Fort Whipple, Virginia.
Edward A. Lewis.....	Apr. 26, 1872	.....	May 20, 1872	On duty as assistant at Cincinnati, Ohio.
W. O. Bailey.....	May 3, 1872	May 28, 1872	Aug. 31, 1872	On duty as assistant at Keokuk, Iowa.
William Finn.....	May 3, 1872	May 28, 1872	June 17, 1872	On duty as assistant at Pittsburgh, Pennsylvania.
Frank H. Wash.....	May 3, 1872	May 28, 1872	June 17, 1872	On duty as assistant at Mobile, Alabama.
William D. Wright.....	May 3, 1872	May 28, 1872	June 1, 1872	On duty as assistant at Davenport, Iowa.
John D. M. Fee.....	May 10, 1872	June 8, 1872	July 27, 1872	On duty as assistant at Chicago, Illinois.
George W. McKeo.....	May 11, 1872	.....	June 17, 1872	On duty as assistant at Omaha, Nebraska.
P. G. Deltz.....	May 11, 1872	June 8, 1872	June 17, 1872	On duty as assistant at Wilmington, North Carolina.
E. B. Robbins.....	May 17, 1872	June 17, 1872	July 9, 1872	On duty as assistant at Norfolk, Virginia.
S. P. Ruthven.....	May 17, 1872	.....	.....	On station-duty at office of the Chief Signal-Officer.
H. M. Ludwig.....	May 24, 1872	June 15, 1872	June 17, 1872	On duty as assistant at Louisville, Kentucky.

TABLE IV.—Number of enlisted men instructed, &c.—Continued.

Name.	Placed under instruction for assistant.	Reported qualified as assistant.	Ordered on station.	Remarks.
E. F. McComas	May 24, 1872	June 15, 1872	June 17, 1872	On duty as assistant at Oswego, New York.
W. U. Simons	June 7, 1872	June 27, 1872	Aug. 9, 1872	On duty as assistant at Jacksonville, Florida.
James Brown	June 7, 1872	June 27, 1872	June 27, 1872	Ordered to Fort Whipple, Virginia, for misconduct; deserted.
D. C. Ralston	June 27, 1872	July 27, 1872	Aug. 20, 1872	On duty as assistant at New Orleans, Louisiana.
Mark Downing	July 19, 1872	Aug. 19, 1872	.....	Awaiting orders at Fort Whipple, Virginia.
A. G. Tassin	July 19, 1872	Aug. 26, 1872	Sept. 3, 1872	On duty as assistant at Cincinnati, Ohio.
W. R. Nuzum	July 19, 1872	.....	Sept. 9, 1872	Ordered to Fort Whipple, Virginia, for misconduct.
James Courtney	Aug. 16, 1872	Sept. 10, 1872	Sept. 13, 1872	On duty as assistant at Milwaukee, Wisconsin.
H. R. Stockman	Aug. 16, 1872	Sept. 10, 1872	Sept. 13, 1872	On duty as assistant at Philadelphia, Pennsylvania.
J. B. Campbell	Aug. 23, 1872	Sept. 21, 1872	.....	Awaiting orders at Fort Whipple, Virginia.
Lawrence Danne	Aug. 23, 1872	Sept. 21, 1872	Sept. 24, 1872	On duty as assistant at Boston, Massachusetts.
John McGuire	Aug. 17, 1872	Sept. 10, 1872	.....	Awaiting orders at Fort Whipple, Virginia.
B. C. Anderson	Aug. 30, 1872	.....	.....	Still under instruction.
George Onslow	Aug. 30, 1872	.....	.....	Do.
Edgar Green	Aug. 30, 1872	Sept. 23, 1872	Sept. 24, 1872	On duty as assistant at Saint Louis, Missouri.
William McGillivray	Aug. 30, 1872	Sept. 23, 1872	Sept. 24, 1872	On duty as assistant at Savannah, Georgia.
John H. Baer	Sept. 6, 1872	.....	.....	Still under instruction.
Newton Phelps	May 11, 1872	June 8, 1872	June 17, 1872	On duty as assistant at Portland, Maine.
Thomas Cleary	Sept. 12, 1872	.....	.....	Still under instruction.
E. F. Maynard	Aug. 4, 1871	.....	Aug. 4, 1871	Promoted to rank of sergeant; in charge of station at Cincinnati, Ohio.
Edward Lloyd	July 24, 1871	.....	July 24, 1871	Promoted to rank of sergeant; in charge of station at Indianola, Texas.
Samuel W. Beall	Sept. 25, 1871	.....	Sept. 25, 1871	Promoted to rank of sergeant; in charge of station at Corinne, Utah Territory.
Max Marix	Sept. 11, 1871	.....	Sept. 11, 1871	Promoted to rank of sergeant; in charge of station at Daytonport, Iowa.
W. S. Jewell	Dec. 6, 1871	.....	Dec. 6, 1871	On station-duty at office of the Chief Signal-Officer.
George A. Clum	Oct. 23, 1871	.....	Oct. 23, 1871	Promoted to rank of sergeant; in charge of station at Montgomery, Alabama.
James O'Dowd	June 12, 1871	.....	June 12, 1871	Promoted to rank of sergeant; in charge of station at Lake City, Florida.
William T. Boyd	Dec. 11, 1871	.....	Dec. 11, 1871	Promoted to rank of sergeant; in charge of station at Philadelphia, Pennsylvania.
Harry Barton	Aug. 28, 1871	.....	Aug. 28, 1871	Promoted to rank of sergeant; in charge of station at Omaha, Nebraska.
T. B. Jennings	Nov. 3, 1871	.....	Nov. 3, 1871	Promoted to rank of sergeant; on station duty at office of the Chief Signal-Officer.
William Theodovins	Dec. 20, 1871	.....	Dec. 20, 1871	Promoted to rank of sergeant; in charge of station at Punta Rassa, Florida.
David H. Sackett	Dec. 11, 1871	.....	Dec. 11, 1871	Promoted to rank of sergeant; in charge of station at Milwaukee, Wisconsin.
William Line	May 18, 1871	.....	May 18, 1871	Promoted to rank of sergeant; on duty on station at Mount Washington, New Hampshire.
R. J. Bell	May 23, 1871	.....	May 23, 1871	Promoted to rank of sergeant; in charge of station at Esconawba, Michigan.
J. K. P. Purdum	June 12, 1871	.....	June 12, 1871	Ordered to Fort Whipple, Virginia, for promotion.
J. F. Tenney	Jan. 1, 1872	.....	.....	Still under instruction.

TABLE V.—Showing stations inspected, by whom, and when inspected.

Stations.	Name of inspector.	Date.
Augusta, Georgia	First Lieut. H. Jackson, acting signal-officer	October 7, 1871
Baltimore, Maryland	First Lieut. C. S. Smith, acting signal-officer	March 23, 1871
Boston, Massachusetts	First Lieut. L. B. Norton, acting signal-officer	June 23-24, 1871
Breckenridge, Minnesota	Second Lieut. A. W. Greely, acting signal-officer	April 3, 1872
Buffalo, New York	First Lieut. L. B. Norton, acting signal-officer	August 8, 1871
Burlington, Vermont	Second Lieut. A. W. Greely, acting signal-officer	April 29, 1872
Cairo, Illinois	First Lieut. Charles S. Smith, acting signal-officer	Sept. 15, 1872
Cape May, New Jersey	First Lieut. L. B. Norton, acting signal-officer	August 24, 1871
Corinne, Utah Territory	First Lieut. Robert Craig, acting signal-officer	July 23-26, 1872
Charleston, South Carolina	Second Lieut. A. W. Greely, acting signal-officer	May 7, 1872
Chicago, Illinois	First Lieut. H. Jackson, acting signal-officer	November 9, 1871
Cincinnati, Ohio	First Lieut. Charles S. Smith, acting signal-officer	August 9, 1872
Cheyenne, Wyoming Territory	Second Lieut. A. W. Greely, acting signal-officer	July 6-8, 1871
Davenport, Iowa	Second Lieut. A. W. Greely, acting signal-officer	April 13, 1872
Detroit, Michigan	Second Lieut. A. W. Greely, acting signal-officer	Sept. 18-20, 1872
Du Luth, Minnesota	First Lieut. Charles S. Smith, acting signal-officer	July 9, 1872
Escanaba, Michigan	First Lieut. T. R. Adams, acting signal-officer	Sept. 9-11, 1871
Fort Benton, Montana Ter.	First Lieut. C. S. Smith, acting signal-officer	August 26, 1872
Grand Haven, Michigan	First Lieut. T. R. Adams, acting signal-officer	Oct. 10-14, 1871
Galveston, Texas	Second Lieut. H. W. Howgate, acting signal-officer	March 22-23, 1872
Indianapolis, Indiana	Second Lieut. A. W. Greely, acting signal-officer	Sept. 15-17, 1872
Indianola, Texas	First Lieut. H. Jackson, acting signal-officer	Dec. 14, 1871
Jacksonville, Florida	First Lieut. Charles S. Smith, acting signal-officer	August 21, 1872
Keokuk, Iowa	First Lieut. T. R. Adams, acting signal-officer	Sept. 4-6, 1872
Key West, Florida	First Lieut. T. R. Adams, acting signal-officer	Sept. 1-3, 1871
Knoxville, Tennessee	First Lieut. C. S. Smith, acting signal-officer	Sept. 18, 1872
Leavenworth, Kansas	First Lieut. T. R. Adams, acting signal-officer	Sept. 16-17, 1871
Lake City, Florida	Second Lieut. A. W. Greely, acting signal-officer	Sept. 28, 1872
Louisville, Kentucky	First Lieut. T. R. Adams, acting signal-officer	Sept. 7-8, 1871
Lynchburgh, Virginia	First Lieut. Charles S. Smith, acting signal-officer	Sept. 7, 1872
Mt. Washington, N. Hampshire ..	First Lieut. H. Jackson, acting signal-officer	October 24, 1871
Marquette, Michigan	Second Lieut. A. W. Greely, acting signal-officer	July 22-23, 1872
Memphis, Tennessee	Second Lieut. A. W. Greely, acting signal-officer	Sept. 3, 1872
Milwaukee, Wisconsin	First Lieut. H. Jackson, acting signal-officer	Dec. 30, 1871
Mobile, Alabama	Second Lieut. A. W. Greely, acting signal-officer	July 23-24, 1872
Nashville, Tennessee	First Lieut. C. S. Smith, acting signal-officer	March 4, 1872
New London, Connecticut	First Lieut. H. Jackson, acting signal-officer	Dec. 18, 1871
New Orleans, Louisiana	First Lieut. Charles S. Smith, acting signal-officer	Aug. 17, 1872
New York City, New York	First Lieut. C. S. Smith, acting signal-officer	February 12, 1872
Norfolk, Virginia	First Lieut. T. R. Adams, acting signal-officer	Nov. 7-8, 1871
Oswego, New York	First Lieut. C. S. Smith, acting signal-officer	July 22, 1872
Omaha, Nebraska	First Lieut. H. Jackson, acting signal-officer	Nov. 29, 1871
Philadelphia, Pennsylvania	Second Lieut. A. W. Greely, acting signal-officer	Sept. 5-6, 1872
Pittsburgh, Pennsylvania	First Lieut. H. Jackson, acting signal-officer	October 12, 1871
Portland, Maine	First Lieut. C. S. Smith, acting signal-officer	Oct. 9, 1872
Punta Rassa, Florida	First Lieut. T. R. Adams, acting signal-officer	Oct. 14-18, 1871
Rochester, New York	Second Lieut. A. W. Greely, acting signal-officer	Aug. 26-30, 1872
	First Lieut. H. Jackson, acting signal-officer	Nov. 11-12, 1871
	Second Lieut. A. W. Greely, acting signal-officer	July 18, 1872
	First Lieut. C. S. Smith, acting signal-officer	May 22-23, 1872
	First Lieut. T. R. Adams, acting signal-officer	Sept. 18-20, 1871
	First Lieut. C. S. Smith, acting signal-officer	Sept. 27, 1872
	First Lieut. H. Jackson, acting signal-officer	November 6, 1871
	Second Lieut. A. W. Greely, acting signal-officer	Aug. 23-25, 1872
	First Lieut. T. R. Adams, acting signal-officer	Sept. 13-15, 1871
	First Lieut. C. S. Smith, acting signal-officer	September 4, 1872
	First Lieut. H. Jackson, acting signal-officer	October 17, 1871
	Second Lieut. A. W. Greely, acting signal-officer	August 2-6, 1872
	First Lieut. T. R. Adams, acting signal-officer	Oct. 19-23, 1871
	First Lieut. C. S. Smith, acting signal-officer	July 26, 1872
	Second Lieut. A. W. Greely, acting signal-officer	August 23, 1872
	First Lieut. H. Jackson, acting signal-officer	April 21, 1871
	Second Lieut. A. W. Greely, acting signal-officer	August 1, 1872
	First Lieut. L. B. Norton, acting signal-officer	July 17, 1871
	Second Lieut. A. W. Greely, acting signal-officer	April 16, 1872
	First Lieut. H. Jackson, acting signal-officer	Sept. 29, 1871
	First Lieut. C. E. Kilbourne, acting signal-officer	June 29, 1872
	First Lieut. L. B. Norton, acting signal-officer	August 17, 1871
	Second Lieut. A. W. Greely, acting signal-officer	June 3-5, 1872
	First Lieut. H. Jackson, acting signal-officer	December 4, 1871
	Second Lieut. A. W. Greely, acting signal-officer	Sept. 8-14, 1872
	First Lieut. L. B. Norton, acting signal-officer	July 1, 1872
	Second Lieut. A. W. Greely, acting signal-officer	April 7, 1872
	First Lieut. L. B. Norton, acting signal-officer	July 25, 1871
	First Lieut. H. Jackson, acting signal-officer	January 1, 1872
	Second Lieut. H. W. Howgate, acting signal-officer	March 20-21, 1872
	Second Lieut. A. W. Greely, acting signal-officer	May 15, 1872
	First Lieut. C. S. Smith, acting signal-officer	February 20, 1872
	First Lieut. L. B. Norton, acting signal-officer	August 17, 1871
	First Lieut. R. Craig, acting signal-officer	July 18-21, 1872

TABLE V.—*Showing stations inspected, by whom, and when inspected—Continued.*

Stations.	Name of inspector.	Date.
Savannah, Georgia	First Lieut. H. Jackson, acting signal-officer.....	October 10, 1871
Shreveport, Louisiana.....	First Lieut. C. S. Smith, acting signal-officer.....	March 13, 1872
Saint Louis, Missouri.....	First Lieut. H. Jackson, acting signal-officer.....	November 2, 1871
Saint Paul, Minnesota.....	Second Lieut. A. W. Greely, acting signal-officer.....	Aug. 12-13, 1872
Toledo, Ohio	First Lieut. H. Jackson, acting signal-officer.....	Nov. 11, 1871
Vicksburgh, Mississippi	First Lieut. C. S. Smith, acting signal-officer	August 13, 1872
Virginia City, Montana Ter....	First Lieut. H. Jackson, acting signal-officer.....	Dec. 11, 1871
Wilmington, North Carolina ...	First Lieut. C. S. Smith, acting signal-officer.....	Sept. 11, 1872
	First Lieut. T. R. Adams, acting signal-officer	Sept. 1-2, 1871
	Second Lieut. A. W. Greely, acting signal-officer....	Aug. 17-20, 1872
	Second Lieut. A. W. Greely, acting signal-officer....	Sept. 23, 1872
	First Lieut. H. Jackson, acting signal-officer.....	October 4, 1871
	First Lieut. C. S. Smith, acting signal-officer.....	July 12, 1872

TABLE VI.—*Exhibiting the communications sent from and received at the office of the Chief Signal-Officer (exclusive of telegrams) from November 1, 1871, to September 30, 1872.*

SENT.

DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

To heads of Departments and Bureaus	92
To observer-sergeants in reference to their duties.....	7,215
In reply to applications for stations and others similar.....	94
To telegraph companies in reference to transmission of weather-reports....	614
To boards of trade, chambers of commerce, agricultural societies, &c....	4,988
To foreign correspondents relating to this division.....	3,202
General and special orders with reference to this division.....	1,866
Miscellaneous.....	1,136
Total.....	19,207

SIGNAL DIVISION.

To heads of Departments and Bureaus	241
Relating to duties and discipline at Signal-Service School of Instruction and post of Fort Whipple, Virginia.....	718
Relating to recruiting and enlistment.....	48
Answers to applications for appointment in the signal service, United States Army.....	315
General and special orders with reference to this division.....	376
Miscellaneous.....	107
Total.....	1,705

PROPERTY DIVISION.

To heads of Departments and Bureaus.....	288
To manufacturers and others in reference to instruments, equipments, &c....	546
To observer-sergeants and other enlisted men in reference to property and money accounts.....	6,188
In reference to quarterly returns of officers	52
Miscellaneous.....	8,004
Total	15,078
Aggregate.....	35,990

RECEIVED.

DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

From heads of Departments and Bureaus	109
Applications for establishment of new stations	147
From telegraph companies in reference to transmission of weather-reports	310
From observer-sergeants in reference to their duties	5, 112
From boards of trade, chambers of commerce, and agricultural societies	317
From foreign correspondents relating to this division	83
Special applications for suggestions for practical use of weather-maps, &c.	125
Reports relative to instruction of observer-sergeants and assistants	929
Mailed reports of observer-sergeants on station	153, 582
Miscellaneous	1, 202
Total	161, 916

SIGNAL DIVISION.

From heads of Departments and Bureaus	163
Relating to duties and discipline at Signal-Service School of Instruction and post of Fort Whipple, Virginia	671
Relating to instruction in signaling at Fort Whipple, Virginia, and in different military departments	684
Relating to recruiting and enlistment	85
Applications for appointment in the signal service, United States Army ..	310
Miscellaneous	301
Total	2, 214

PROPERTY DIVISION.

From head of Departments and Bureaus	167
From manufacturers and others relating to instruments, equipments, &c.	539
From officers concerning property, quarterly returns, &c.	983
From observer-sergeants and other enlisted men relating to property and money accounts	4, 049
Regarding property transferred to stations	3, 128
Miscellaneous	310
Total	9, 176
Aggregate	173, 306
Aggregate sent	35, 990
Aggregate received	173, 306
Total	209, 296

TABLE VII.—Showing the number of meteorological instruments purchased and issued from November 1, 1871, to September 30, 1872.

Instruments.	Barometers.	Thermometers.	Hygrometers.	Anemometers.	Anemoscopes.	Maximum thermometers.	Minimum thermometers.	Aneroid barometers.	Thermometer tubes.
Issued to stations	19	28	46	24	35	26	26	.....	.....
Issued for special uses	11	8	3	6	1	2	2	.....	.....
Issued at last report	57	53	69	61	81	3	3	.....	.....
Returned for repairs, &c.	3	6	12	15	3	2	3	.....	.....
Total number now on station	73	79	103	70	113	27	26	.....	.....
Total number purchased	40	56	50	75	37	16	38	7	7

TABLE VIII.—*List of places for which stations have been requested but not established on September 30, 1872.*

Place.	Applicant.	Date.
Muskegon, Michigan	Hon. H. H. Holt, Michigan legislature, inclosing petition of 99 citizens.	Jan. 21, 1871
	Board of Trade, Toledo	Jan. 27, 1871
	Board of Trade, Chicago	Feb. 10, 1871
	Hon. T. W. Ferry, United States Senate.	March 3, 1871
Manitowoc, Wisconsin	Hon. P. Sawyer, M. C.	Jan. 25, 1871
Dubuque, Iowa	Doctor A. Munsell	Jan. 26, 1871
	Board of Trade, Toledo	Jan. 27, 1871
Huron City, Michigan	Board of Trade, Cleveland	Feb. 19, 1871
	Board of Trade, Detroit	Feb. 19, 1871
Mackinac	Board of Trade, Chicago	Feb. 10, 1871
Richmond, Virginia	W. G. Turpin	April 3, 1871
Cape Henry, Virginia	Board of Trade, Norfolk, Virginia, and resolution of the general assembly of Virginia.	April 17, 1871
Body Island		
Cape Hatteras, North Carolina.		
Lewes, Delaware	Board of Trade, Philadelphia	May 25, 1871
Park's, Colorado	E. J. Mallett, late consul-general	May 24, 1871
Staten Island	C. Keutgen, jr.	June 9, 1871
	Hon. John Scott, United States Senate.	June 12, 1871
Chambersburgh, Pennsylvania	Hon. Simon Cameron, United States Senate.	June 12, 1871
Watertown, New York	L. L. Pratt	June 21, 1871
Xenia, Ohio	C. E. Case	June 30, 1871
Port Hope	Board of Trade, Detroit, Michigan.	July 22, 1871
Illinois Industrial University, Champaign, Illinois.	Hon. W. C. Flagg, secretary	July 21, 1871
	Hon. J. M. Gregory, president	Feb. 21, 1872
Little Rock, Arkansas	Hon. J. M. Hanks, M. C.	July 26, 1871
	Albert Cohen	July 1, 1872
	J. N. Hoag, secretary California State Board of Agriculture.	July 26, 1871
Sacramento, California	Concurrent resolution of the legislature of California, presented by Dr. T. M. Logan, secretary State Board of Health.	Jan. 10, 1872
		May 15, 1872
Niles, Michigan	J. B. Fitzgerald, secretary Berrien County Agricultural Society.	July 27, 1871
Hot Springs, Arkansas	J. H. Morton, M. D.	Aug. 2, 1871
Louisiana, Missouri	William Stark	Aug. 3, 1871
	R. E. Pleasants	
Janesville, Wisconsin	J. B. Whiting, M. D.	Aug. 7, 1871
	Rock County Agricultural Society.	
Hillsdale, Michigan	Professor George M. Millen, secretary Hillsdale College.	Aug. 6, 1871
Metamora, Illinois	Hillsdale County Agricultural Society	Aug. 6, 1871
	Edward Kipp, secretary Woodford County Agricultural Society.	Aug. 8, 1871
Marietta, Ohio	J. W. Andrews, president Marietta College.	Aug. 10, 1871
	Washington County Agricultural Society.	Aug. 10, 1871
Mount Pleasant Academy, Pennsylvania.	W. H. McCrery, Mount Pleasant Academy and Normal School.	Aug. 11, 1871
Nebraska City	H. K. Raymond, secretary Otoe County Farmers' Club.	Aug. 14, 1871
Mount Moosilauke	Professor C. H. Hitchcock	Aug. 16, 1871
	A. F. Clough	Aug. 16, 1871
Catasauqua, Pennsylvania	Hon. E. McPherson, Clerk of United States House of Representatives.	Sept. 11, 1871
Galena, Illinois	D. Wilmot Scott, editor Galena Commercial Advertiser.	Sept. 14, 1871
Columbus, Nebraska	J. O. Shannou, secretary Platte County Agricultural Society.	Sept. 5, 1871

TABLE VIII.—List of places for which stations have been requested, &c.—Continued.

Place.	Applicant.	Date.
Canada—Farther Point.....	Oswego Board of Trade, by J. L. McWhorter.	Aug. 30, 1871
Coburg		
Collingwood.....		
Springfield, Missouri	John E. Worth, for Greene County Agricultural and Mechanical Society.	Sept. 18, 1871
Port Huron	Board of Trade, Buffalo.....	Sept. 22, 1871
Yankton, Dakota Territory.....	Hon. M. K. Armstrong, Delegate House of Representatives.	Oct. 5, 1871
Mason City, Iowa.....	S. V. Clevenger.....	April 26, 1872
	T. G. Emsley, secretary Cerro Gordo County Agricultural Society.	Oct. 6, 1871
Orono, Maine	M. C. Fernald, Maine State College of Agriculture.	Oct. 19, 1871
Belize, Louisiana	Agent and captains of Morgan Steamship Company.	Oct. 31, 1871
Fort Morgan, Alabama		
Waco, Texas		
Fort Randall, Dakota Territory..	R. J. Percy, for Missouri Valley Telegraph Company.	Nov. 9, 1871
Pike's Peak	W. W. Allen, Colorado Springs colony..	Nov. 15, 1871
University of Michigan, Ann Arbor.	Professor G. B. Merriman.....	Nov. 23, 1871
Canada—Fort Garry	N. McDougall.....	Dec. 2, 1871
Fountain, Colorado Territory.....	R. F. Song, editor El Paso Ranchman ..	Dec. 4, 1871
Erie, Pennsylvania.....	Hon. G. W. Scofield, M. C.	Jan. 11, 1872
Bangor, Maine.....	C. A. Boutelle, editor Whig and Courier..	Dec. 14, 1871
Vineyard Haven, Massachusetts.	Professor J. E. Hilgard, United States Coast Survey.	Dec. 18, 1871
	Daniel W. Stevens.....	
	Rev. Thomas Hill	
Newport, Rhode Island.....	Hon. H. B. Anthony, United States Senate, forwarding memorial of 29 citizens.	Dec. 8, 1871
	Captain S. A. Day, United States Army..	
Cape Ann, Massachusetts	Hon. B. F. Butler, M. C.	July 26, 1872
Wytheville, Virginia	Hon. W. Terry, M. C.	Dec. 19, 1871
Iowa City.....	John P. Irish	Dec. 20, 1871
Manassas, Virginia	George C. Round.....	Dec. 14, 1871
Quincy, Illinois	H. A. Hill, secretary National Board of Trade	Dec. 27, 1871
Dover Point, New Hampshire....	John B. Stevens, mayor.....	Jan. 4, 1872
Wilmington, Delaware	Board of Trade.....	Jan. 13, 1872
New Haven, Connecticut.....	Hon. S. W. Kellogg, M. C., inclosing petition of citizens.....	Jan. 24, 1872
	Thomas Trowbridge, president Chamber of Commerce.....	
	Faculty Sheffield Scientific School, Yale College.....	
Additional stations on eastern shore of Lake Michigan.	Hon. H. H. Holt, Michigan legislature.	Jan. 13, 1872
Additional stations on mountains of Virginia.	G. C. Wedderburn, secretary Virginia Telegraph Company.	Feb. 11, 1871
	L. A. Gobright, Associated Press....	
Additional stations on western slope of Mississippi Valley.	George P. Plant.....	May 7, 1871
	W. H. Scudder	
Nobsco Light, Monomdy Point, Cape Cod, Massachusetts.	R. P. Fansey, committee of Merchants' Exchange, Saint Louis, Missouri.	July 16, 1871
	B. B. Forbes, recommended by Hon. James Buffinton, M. C.	
Southwest Pass, Pass à l'oultre..	Thornton A. Jenkins, rear-admiral, United States Navy.	Nov. 29, 1871
Staunton, Virginia; Christianburgh, Virginia; Bristol, Tennessee; Easton, Pennsylvania; Harrisburgh, Pennsylvania; Winchester, Virginia.	Jed. Hotchkiss	March 20, 1871
		Aug. 15, 1871

TABLE VIII.—*List of places for which stations have been requested, &c.*—Continued.

Place.	Applicant.	Date.
Towanda, Kansas.....	M. D. Ellis.....	Feb. 12, 1872
Black Dome, Black Mountain, North Carolina.....	William Cain.....	Feb. 12, 1872
Charlotte, New York.....	J. Eaton and thirty-five others.....	Feb. 14, 1872
Gallitzin, Altoona, on Pennsylv- ania Central Railroad.....	David Peelor.....	Feb. 17, 1872
University of Minnesota. Min- neapolis.....	William W. Folwell, president.....	Feb. 21, 1872
Morgantown, West Virginia.....	Hon. A. J. Boreman, United States Senate.....	Feb. 23, 1872
	Alexander Martin, president West Vir- ginia University.....	
	Hon. J. C. McGrew, M. C.....	
	Hon. Frank Hereford, M. C.....	
	U. E. Davis.....	July 22, 1872
Each of the State Agricultural Colleges.....	George C. Sturgiss.....	
Columbus, Ohio.....	J. B. Bowman, regent Kentucky Uni- versity, and others.....	Feb. 29, 1872
Norwich University, Northfield, Vermont.....	J. H. Khippart, secretary of Ohio State Board of Agriculture.....	March 5, 1872
Grand Tower, Illinois.....	Captain C. A. Curtis.....	March 15, 1872
Iuka, Mississippi.....	A. R. Harris.....	March 21, 1872
	Rev. J. T. Freeman, through Hon. George E. Harris, M. C.....	March 25, 1872
Groat Natihalee, Bald Mountain, North Carolina.....	Charles W. Jenks.....	April 1, 1872
Deposit, New York.....	G. W. Hanford.....	April 1, 1872
Heilman Dale.....	S. P. Heilman.....	April 1, 1872
Colorado Springs, Colorado.....	Robert H. Lamborn.....	April 5, 1872
Booneville, Missouri.....	J. L. Stephens.....	April 11, 1872
Fort Wayne, Indiana.....	F. C. Johnson, Indiana State Board of Agriculture.....	April 12, 1872
New Albany, Indiana.....	F. C. Johnson, Indiana State Board of Agriculture.....	April 12, 1872
Maryland Agricultural College.....	A. R. Davis, president board of trus- tees.....	April 19, 1872
San Antonio, Texas.....	Thomas G. Williams.....	May 10, 1872
Atlanta, Georgia.....	Hon. John H. James, mayor.....	May 10, 1872
Auburn, Alabama; Agricultur- al and Mechanical College of Alabama.....	William C. Stubbs.....	May 14, 1872
	John B. Read.....	
Racine, Wisconsin.....	W. H. Jenison.....	May 18, 1872
	Mayor and council.....	
Ogdensburgh, N. Y.....	Hon. W. A. Wheeler, M. C.....	May 25, 1872
Plattsburgh, New York.....	Hon. John Rogers, M. C.....	May 28, 1872
Sewanee, Tennessee.....	John L. Cooper, through Professor Jo- seph Henry, Smithsonian Institution.....	June 10, 1872
Newark College, Delaware.....	William D. Mackey, secretary.....	June 11, 1872
Green Bay, Wisconsin.....	Hon. P. Sawyer, M. C.....	June 13, 1872
Kenosha, Wisconsin.....	Wallace Mygatt.....	June 20, 1872
Warsaw, Indiana.....	Marshall H. Parks.....	June 24, 1872
Beaver City, Utah Territory.....	Daniel Tyler.....	July 8, 1872
New Ulm, Minnesota.....	Dr. Alfred Müller.....	July 10, 1872
	F. C. Johnson.....	July 13, 1872
	P. Hornbrook, surveyor of customs.....	
Evansville, Indiana.....	Thomas P. Britton, president Vander- burgh County Agricultural Society.....	
	John Ingle, secretary Vanderburgh County Agricultural Society.....	
	Charles H. Butterfield, mayor.....	July 16, 1872
Aiken, South Carolina.....	Hon. F. A. Sawyer, United States Sen- ate, and sixteen citizens.....	
	J. C. Derby.....	Sept. 2, 1872

TABLE VIII.—*List of places for which stations have been requested, &c.*—Continued.

Place.	Applicant.	Date.
Winona, Mississippi.....	A. M. Rafter.....	July 20, 1872
Eutaw, Alabama.....	W. S. Bird.....	July 20, 1872
Belfast, Maine.....	George E. Brackett.....	Aug. 6, 1872
Ithaca, New York, Cornell University.....	A. D. White, president; petition of seventy-five citizens.	Aug. 8, 1872
Straits of Mackinac.....	Roys I. Cram.....	Aug. 7, 1872
Carthage, Illinois.....	L. F. M. Easterday; petition of one hundred and five citizens.	Sept. 2, 1872
Kutztown, Pennsylvania.....	A. R. Hornel, principal Keystone State Normal School.	Sept. 13, 1872

TABLE IX.—*List of agricultural societies which on September 30, 1872, had appointed permanent committees to confer with the Chief Signal-Officer of the Army.*

Name of organization.	State.	Committee.	Post-office address.
Monroe County Agricultural Society.	Indiana.....	T. H. Mallow.....	Bloomington, Ind.
Muskingum County Agricultural Society.	Ohio.....	R. S. Mershon.....	Zanesville, O.
Louisville and Jefferson Counties Agricultural Society.	Kentucky.....	L. Young.....	Louisville, Ky.
Schuyler County Agricultural and Mechanical Society.	Missouri.....	John B. Glaze.....	Glenwood, Mo.
Highland County Agricultural Society.	Ohio.....	J. S. Bell.....	Hillsborough, O.
Arkansas State Agricultural and Mechanical Society.	Arkansas.....	J. W. Ellis.....	Little Rock, Ark.
Bertie County Agricultural Society.	North Carolina.....	Albert Cohen.....	Little Rock, Ark.
Geauga County Agricultural Society.	Ohio.....	S. J. Wheeler.....	Windsor, N. C.
Otsego County Agricultural Society.	New York.....	J. B. Cheney.....	Burton, O.
Crawford County Agricultural Society.	Pennsylvania.....	D. E. Tayloe.....	Do.
Berrien County Agricultural Society.	Michigan.....	Dexter Witter.....	Do.
Greene County Agricultural Society.	Missouri.....	Geo. H. Ford.....	Cooperstown, N. Y.
Tolland County Agricultural Society.	Connecticut.....	Luther Russell.....	Do.
Burlington County Agricultural Society.	New Jersey.....	G. Pomeroy Keese.....	Do.
Agricultural and Mechanical Society of Western Alabama.	Alabama.....	H. M. Hooker.....	Do.
Crawford County Agricultural Society.	Ohio.....	Elisha Finney.....	Conneautville, Pa.
Saratoga County Agricultural Society.	New York.....	A. P. Foster.....	Do.
Martin County Agricultural Society.	Minnesota.....	Col. F. Maaton.....	Do.
California State Board of Agriculture.	California.....	Prof. W. H. Armstrong.....	Do.
Macon County Fruit Growers' Association.	Illinois.....	J. B. Fitzgerald.....	Niles, Mich.
Missouri State Board of Agriculture.	Missouri.....	D. O. Woodruff.....	Do.
Jackson County Agricultural Society.	Ohio.....	Wm. Bort.....	Do.
		Dr. J. E. Taft.....	Springfield, Mo.
		A. W. McPherson.....	Do.
		Rev. John E. Werth.....	Do.
		Geo. H. Kingsbury.....	Rockville, Conn.
		J. C. Hammond, jr.....	Do.
		G. C. Brown.....	Mount Holly, N. J.
		M. S. Pancoast.....	Do.
		Jas. Lippincott.....	Do.
		W. S. Bird.....	Eutaw, Ala.
		H. G. Webb.....	Do.
		A. T. Lupton.....	Tuscaloosa, Ala.
		G. Keller.....	Bucyrus, O.
		E. R. Reamley.....	Do.
		H. M. Scroggs.....	Do.
		Josiah Koller.....	Do.
		B. S. Robinson.....	Greenfield Centre, N. Y.
		H. A. Munger.....	Fairmount, Minn.
		J. N. Hoag.....	Sacramento, Cal.
		C. F. Reed.....	Do.
		F. M. Logan.....	Do.
		Prof. E. A. Gastman.....	Decatur, Ill.
		Theo. Hildebrandt.....	Do.
		J. B. R. Sherrick.....	Do.
		John H. Tice.....	Saint Louis, Mo.
		Rev. Chas. Peabody.....	Do.
		Hon. G. W. Kinney.....	Snow Hill, Mo.
		Davis Mackley.....	Jackson C. H., O.
		J. E. Ferree.....	Do.
		Jacob Dungan.....	Do.

TABLE IX.—List of agricultural societies, &c.—Continued.

Name of organization.	State.	Committee.	Post-office address.
Pike County Agricultural Society..	Georgia.....	J. S. Pope	Zebulon, Ga.
		J. H. Mitchell	Do.
		H. Green	Do.
Greene County Agricultural So-	New York	A. P. Jones	Catskill, N. Y.
ciety.		G. C. Mott	Do.
York County Agricultural Society.	Pennsylvania...	John Evans	York, Pa.
		G. A. Heckert	Do.
		W. S. Roland	Do.
Allamakee County Agricultural	Iowa.....	C. D. Beeman	Waukon, Iowa.
County.			
Bay District Horticultural Society	California.....	F. A. Miller	San Francisco, Cal.
of California.		Prof. H. N. Bolender	Do.
Maine Board of Agriculture	Maine	M. C. Fernald	Orono, Me.
		Prof. G. L. Goodale	Bowdoin Coll'ge, Bruns-
			wick, Me.
		Prof. C. E. Hamlin	Colby Univ'y, Water-
			ville, Me.
		C. F. Breckett	Bowdoin Coll'ge, Bruns-
			wick, Me.
Tuscola County Agricultural So-	Michigan	Hon. S. F. Perley	Naples, Me.
ciety.		C. C. Stoddard	Fair Grove, Mich.
		Townsend North	Do.
Central Iowa District Agricultural	Iowa.....	Dr. Wm. Johnson	Do.
Association.		P. F. Bartle	Des Moines, Iowa.
		M. W. Robinson	Do.
		D. V. Cate	Do.
South Carolina Agricultural and	South Carolina..	Dr. F. P. Porcher	Charleston, S. C.
Mechanical Society.		Dr. T. T. Robertson	Winnsborough, S. C.
		Col. J. P. Thomas	Columbia, S. C.
Connecticut State Board of Agri-	Connecticut	Hon. E. H. Hyde	Stafford, Conn.
culture.		Hon. Thos. H. Butler	Norwalk, Conn.
		H. S. Collins	Collinsville, Conn.
Terre Haute Horticultural Society.	Indiana	J. D. Foote	Terre Haute, Ind.
		J. F. Saule	Do.
		John Weir	Do.
		Rev. — Stimson	Do.
		Jos. Gilbert	Do.
Pope County Agricultural Asso-	Arkansas	John B. Bezzo	Moreland, Ark.
ciation.		W. W. Brasher	Do.
		W. A. Stuart	Russellville, Ark.
Middlesex County Farmers' Club.	New Jersey.....	G. W. Thompson	New Brunswick, N. J.
Farmers' Club	Utah.....	D. Tyler	Beaver City, Utah Ter.
		Wm. Fotheringham	Do.
		J. L. Smith	Do.
Indiana State Board of Agricul-	Indiana	T. C. Johnson	New Albany, Ind. *
ture.		Thos. Dowling	Terre Haute, Ind.
Rhode Island Society for the En-	Rhode Island ...	J. D. G. Nelson	Fort Wayne, Ind.
couragement of Domestic Indus-		Dr. J. W. Sawyer	Providence, R. I.
try.		J. T. Smith	Do.
Washington County Agricultural	New York	Dr. W. F. Channing	Do.
Society.		M. Ingalsbe	South Hartford, N. Y.
Farmers' and Fruit Growers' Asso-	Illinois.....	R. W. Pratt	Do.
ciation of Illinois.		Dr. W. West	Belleville, Ill.
		F. H. Pieper	Do.
		E. W. West	Do.
Iowa State Horticultural Society..	Iowa.....	Prof. Chas. E. Bessey..	State Agricul. College,
			Ames, Iowa.
		Hon. John Scott	Nevada, Iowa.
		G. B. Brackett	Denmark, Iowa.
Addison County Agricultural So-	Vermont.....	Prof. W. H. Parker	Middlebury College,
ciety.			Middlebury, Vt.
		Prof. H. M. Seeley	Middlebury College,
			Middlebury, Vt.
		Prof. E. Brainerd	Middlebury College,
			Middlebury, Vt.
Orleans County Agricultural So-	Vermont.....	D. M. Camp	Newport, Vt.
ciety.		T. H. Haskins	Do.
Bradley County Agricultural and	Tennessee	Z. E. Jameson	Irishburgh, Vt.
Mechanical Society.		T. L. Cate	Cleveland, Tenn.
		J. C. Morgan	Do.
Iowa State Agricultural Society ...	Iowa.....	Dr. G. A. Long	Do.
		Peter Melendy	Cedar Falls, Iowa.
		S. B. Hewitt, jr.	Eagle Grove, Iowa.
		J. M. Shaffer	Fairfield, Iowa.
Carroll and Choctaw Counties Ag-	Mississippi	A. M. Rafter	Winona, Miss.
ricultural Society.		T. J. Blackmore	Do.
		O. J. Moore	Do.
Belmont Farmers' Club	Mississippi	A. M. Rafter	Winona, Miss.
		W. W. Dabney	Do.
		Jas. Thompson	Do.

TABLE IX.—*List of agricultural societies, &c.*—Continued.

Name of organization.	State.	Committee.	Post-office address.
Broome County Agricultural Society.	New York	E. G. Crafts	Binghamton, N. Y.
		T. S. Roberts	Do.
		Arch. Stone	Do.
Bureau County Agricultural Society.	Illinois	P. Van Vredenberg	Do.
		Geo. W. Stone	Princeton, Ill.
		A. Bryant, jr.	Do.
Essex County Agricultural Society.	Massachusetts	H. L. Baltwood	Do.
		Charles P. Preston	Danvers, Mass.
		William Sutton	Salem, Mass.
		A. W. Dodge	Do.
Kokomo Horticultural Society	Indiana	L. J. Templin	Kokomo, Ind.
		L. W. Leach	Do.
		C. S. Boggs	Do.
		A. M. Jones	Warren, Ill.
Jo Daviess, La Fayette, and Stephenson Union Agricultural Society.	Illinois		
Marshall County Agricultural Society.	Iowa	Byron Webster	Marshalltown, Iowa.
		John Turner	Do.
		S. P. Kinsley	Do.
Coles County Agricultural Society.	Illinois	D. C. M. Evans	Charleston, Ill.
		Charles Penatel	Do.
Rock County Agricultural Society.	Wisconsin	Dr. J. B. Whiting	Janeville, Wis.
Waupaca Agricultural and Mechanical Association.	.....do	H. C. Mead	Waupaca, Wis.
		W. Scott	Do.
Ingham County Agricultural Society.	Michigan	E. Cooleidge	Do.
		Allen Rowe	Mason, Mich.
		A. M. Chapin	Eden, Mich.
		William Rayner	Mason, Mich.
Fillmore and Mower Counties Agricultural Society.	Minnesota	Dr. A. F. Whitman	Spring Valley, Minn.
		H. S. Hart	Do.
		W. L. Kellogg	Do.
		B. F. Farmer	Do.
		William McNee	Do.
		E. S. Burnstead	Do.
		George W. Farmer	Do.
		W. Allen	Do.
		D. Rathbun	Do.
Marion County Agricultural Society.	Ohio	H. M. Ault	Marion, Ohio.
		H. A. True	Do.
Humphreys County Farmer's Club.	Tennessee	J. K. Newcomer	Do.
		Rev. A. A. Wilson	Waverly, Tenn.
		T. U. Harris	Do.
		W. H. Hollinger	Do.
Luzerne County Agricultural Society.	Pennsylvania	A. R. Lankford	Johnsonville, Tenn.
		Steuben Jenkins	Wyoming, Pa.
		Rev. Abel Barker	Do.
		Dr. J. M. Lewis	Do.
		Dr. J. B. Crawford	Wilkesbarre, Pa.
		Dr. C. R. Gorman	Pittston, Pa.
		Dr. B. H. Throop	Scranton, Pa.
		Dr. R. H. Tubbs	Kingston, Pa.
Atlanta Union Central Agricultural Society.	Illinois	S. D. Fisher	Atlanta, Ill.
		William P. Hunt	Do.
Howard County Agricultural Society.	Iowa	Daniel McFarland	McLean, Ill.
		H. D. Noble	Cresco, Iowa.
		Stephen Rodford	Chester, Iowa.
		C. S. Thurber	Cresco, Iowa.
Outagamie County Agricultural Society.	Wisconsin	W. H. P. Bogan	Appleton, Wis.
		Edwin Nye	Freedom, Wis.
		N. B. Clark	Ellington, Wis.
		Louis Perrot	Greenville, Wis.
Lawrence County Agricultural and Industrial Association.	Ohio	Dr. G. S. B. Hempstead	Hanging Rock, Ohio.
		Cyrus Ellison	Ironton, Ohio.
		Hiram Campbell	Do.
		H. W. Gillett	Quaker Bottom, Ohio.
		Samuel Burke	Arabia, Ohio.
Miami County Agricultural Society.	Ohio	W. W. Crane	Tippecanoe City, Ohio.
Michigan State Pomological Society.	Michigan	A. T. Linderman	Grand Rapids, Mich.
		C. L. Whitney	Muskegon, Mich.
		Edward Bradford	Ada, Mich.
Lamoille County Agricultural Society.	Vermont	George Wilkins	Stowe, Vt.
		H. H. Powers	Morrisville, Vt.
		G. L. Waterman	Hyde Park, Vt.
Sheboygan County German Agricultural and Trades Association.	Wisconsin	Ferd. Stoesser	Sheboygan, Wis.
		Frederick Must	Do.
		Frederick Zimmerman	Do.
		Albert Mohlendorf	Do.
		Thomas Blackstock	Do.
Walworth County Agricultural Society.	Wisconsin	Peter Golder	Elk Horn, Wis.
		David Williams	Darien, Wis.
		Charles E. Buhre	Geneva, Wis.

TABLE IX.—*List of agricultural societies, &c.*—Continued.

Name of organization.	State.	Committee.	Post-office address.
Floyd County Agricultural Society.	Iowa.....	E. C. Chapin.....	Charles City, Iowa.
Edgar County Agricultural Society.	Illinois.....	Walter Booth.....	Paris, Ill.
		B. Holcomb.....	Do.
		D. B. Elliott.....	Do.
Perry County Agricultural and Mechanical Association.	Indiana.....	I. T. Patterson.....	Rome, Ind.
		I. I. Wheeler.....	Do.
		Ad. Ackerman.....	Do.
Davis County Agricultural Society.	Iowa.....	Howard Willey.....	Bloomfield, Iowa.
		William J. Hamilton.....	Do.
		T. A. Walker.....	Do.
		A. Rankin.....	Belknap, Iowa.
		William Hill.....	Bloomfield, Iowa.
Utah County Agricultural and Home Manufacturing Society.	Utah.....	Hon. George Bean.....	Provo, U. T.
		C. D. Evans.....	Springville, U. T.
		Daniel Graves.....	Provo, U. T.
Ontario County Agricultural Society.	New York.....	Cooper Sayre.....	Oaks Corners, N. Y.
Washington County Agricultural and Mechanical Association.	Virginia.....	John S. Coe.....	Canandaigua, N. Y.
		Rev. George R. Barr.....	Abingdon, Va.
		J. L. White.....	Do.
Otoe County Horticultural Society.	Nebraska.....	Thomas Cosby.....	Do.
		J. W. Pearman.....	Nebraska City, Neb.
		W. W. Wardell.....	Do.
Lake County Agricultural Society.	.....	D. W. Mead.....	Painesville, Ohio.
		C. C. Jennings.....	Do.
		George Blish.....	Do.
Page County Agricultural Society.	Iowa.....	S. H. Kiddlebaugh.....	Clorinda, Iowa.
		S. W. Peterson.....	Do.
		J. L. Barrett.....	Do.
King's Creek Valley Farmers' Club.	Ohio.....	Thomas Cowgill.....	Kennard, Ohio.
Cerro Gordo County Agricultural Society.	Iowa.....	George R. Miller.....	Mason City, Iowa.
		T. G. Emsley.....	Do.
		A. Wilson.....	Owens Grove, Iowa.
		Henry Martin.....	Mason City, Iowa.
		C. W. Tenney.....	Plymouth, Iowa.
Northumberland County Agricultural Society.	Pennsylvania...	Dr. E. H. Horner.....	Turbotville, Pa.
		William A. Dean.....	Do.
		Thomas Barr.....	Do.
Johnson County Agricultural and Mechanical Association.	Kansas.....	John M. Giffen.....	Olathe, Kan.
		Harry McBride.....	Do.
		J. M. Hadley.....	Do.
Albany County Agricultural and Industrial Society.	New York.....	Hon. Geo. H. Tweddle.....	Albany, N. Y.
		J. Winne.....	Bethlehem Centre, N. Y.
		J. H. Farrell.....	Albany, N. Y.
Pike County Agricultural Society.	Mississippi.....	D. M. Pound.....	Magnolia, Miss.
Warren County Agricultural Society.	New York.....	Charles W. Osborn.....	Warrensburgh, N. Y.
Shenandoah Valley Agricultural Society.	Virginia.....	Edmund Pendleton.....	Winchester, Va.
		Dr. W. J. Best.....	Brucetown, Va.
		J. C. Baker.....	Winchester, Va.
		Jarvis Jennings.....	Millwood, Va.
		Edwin S. Baker.....	Winchester, Va.
Wabunsee County Central Agricultural and Horticultural Society.	Kansas.....	William Coleman.....	Eskridge, Kans.
		William Rinehart.....	Do.
		George Reynolds.....	Do.
Oswego County Agricultural Society.	New York.....	Henry L. Davis.....	Oswego, N. Y.
		P. M. Newton.....	Sandy Creek, N. Y.
		Hiram Walker.....	Union Square, N. Y.
		Thomas H. Austin.....	New Haven, N. Y.
		Harry Palmer.....	Parish, N. Y.
Tennessee Central Fair Association.	Tennessee.....	W. P. Henderson.....	Murfreesboro, Tenn.
Jersey County Agricultural Society.	Illinois.....	Dr. J. O. Hamilton.....	Jerseyville, Illinois.
		George H. Jackson.....	Do.
		William Shephard.....	Do.
Steuben County Agricultural Society.	New York.....	R. E. Robie.....	Bath, N. Y.
Watsonwan County Agricultural Society.	Minnesota.....	W. W. Murphy.....	Madelia, Minn.
Moultrie County Agricultural and Horticultural Society.	Illinois.....	G. W. Vaughan.....	Sullivan, Illinois.
		E. W. Mills.....	Do.

TABLE X.—*List of boards of trade, chambers of commerce, and other organizations, apart from those directly connected with agriculture, which had on September 30, 1872, appointed permanent committees to confer with the Chief Signal-Officer of the Army.*

Name of organization.	State.	Committee.
Chamber of Commerce of New York ..	New York	George W. Dow. M. Maury. J. D. Jones.
Board of Trade of Buffalo	New York	Charles G. Curtis. Alonzo Richmond.
Board of Underwriters of New York ...	New York	George S. Hazard. John H. Vought. Ellwood Walter, secretary.
Board of Trade of Toledo	Ohio	W. T. Walker. M. D. Carrington. A. W. Colton.
Board of Trade of Washington	District of Columbia ..	C. A. King. J. W. Thompson. A. S. Solomons.
Board of Trade of Detroit	Michigan	R. M. Hall. J. Aspinwall. G. U. Bissell.
Board of Trade of Chicago	Illinois	E. W. Hudson. C. Randolph. D. H. Denton.
Board of Trade of Boston	Massachusetts	E. T. Lawrence. Thomas Gaffield. M. D. Ross.
Chamber of Commerce of Milwaukee ..	Wisconsin	John Cummings. E. H. Sampson. Robert S. Perkins.
Board of Trade of Nashville	Tennessee	John L. Hathaway. J. B. Merrill. L. R. Durand.
Chamber of Commerce of Du Luth ...	Minnesota	James Whitworth. R. T. Kirkpatrick. Doctor W. W. Berry.
Board of Trade of Baltimore	Maryland	E. D. Hicks. M. S. Cochrell. Charles M. Cushman.
Board of Trade of New London	Connecticut	H. L. Whitridge. R. R. Kirkland. Benjamin M. Hodges, jr.
Board of Trade of San Francisco	California	J. Hall Pleasants. R. S. Raymond. James T. Skinner.
Board of Trade of Cleveland	Ohio	George F. Rogers. R. R. Swain. J. De Freney.
Chamber of Commerce of Charleston ..	South Carolina	R. G. Sneath. C. A. Low. R. K. Winslow.
Board of Trade of Charleston	South Carolina	R. F. Lyon. J. C. Sage. E. H. Frost.
Chamber of Commerce of Memphis	Tennessee	W. P. Hall. T. W. Dawson. Hon. George A. Trenholm.
Board of Trade of Oswego	New York	Professor F. S. Holme. E. Lafitte. Hon. J. Thompson.
		Colonel Dupree. J. L. McWhorter. A. H. Failing. W. J. Malcolm.

TABLE X.—List of boards of trade, chambers of commerce, &c.—Continued.

Name of organization.	State.	Committee.
Board of Trade of Omaha.....	Nebraska	A. D. Jones. G. H. Collins. M. Stephens. Colonel J. Patrick. O. O. Housel.
Committee appointed by mayor of Rochester.	New York	Joshua A. Eaton. Charles A. Poole. George Schofield. C. H. Farley.
Board of Trade of Portland.....	Maine	J. S. Bedlow. M. N. Rich. Henry Winsor. Thomas C. Hand.
Board of Trade of Philadelphia.....	Pennsylvania.....	Thomas L. Gillespie. George N. Taltham. George N. Allen. James Hand.
Board of Trade of Mobile.....	Alabama	C. Forsyth, secretary. Charles Green, president.
Chamber of Commerce of Savannah...	Georgia.....	Robert N. Gourdon, vice-president.
Chamber of Commerce of Wilmington..	North Carolina	A. H. Van Bokkelen. George Harriass. W. L. De Rossett.
Board of Trade of Norfolk.....	Virginia	Dr. S. K. Jackson. W. A. Graves. E. C. Lindsey. D. M. Berry.
Board of Trade of Indianapolis.....	Indiana.....	E. F. Cox. John E. Wright. W. R. Nofsinger.
Chamber of Commerce of Saint Paul...	Minnesota	S. T. Bowen. R. Ormsby Sweeney. Rev. John Mattocks.
Board of Trade of Burlington.....	Vermont.....	J. Fletcher Williams. G. G. Benedict. Professor Peter Collier.
Merchants' Union Exchange of Saint Louis.	Missouri	Professor McK. Petty. George D. Plant.
Chamber of Commerce of Galveston....	Texas	R. P. Taney. W. H. Scudder. J. S. Thrasher.
Board of Trade of Shreveport.....	Louisiana.....	W. Richardson. C. G. Forshey. George Williams.
Chamber of Commerce of San Diego...	California.....	R. D. Sale. George A. Pike. Douglass Gunn.
Philadelphia County Medical Society...	Pennsylvania	C. A. Jones. J. S. Gordon.
Board of Trade of Davenport.....	Iowa	Lawrence Turnbull. James M. Dalzell.
Board of Trade of Jacksonville.....	Florida	A. S. Baldwin. William P. Milby.
Committee appointed by mayor of Indianola.	Texas	Robert J. Clark. W. H. Woodward. F. E. Hughes.

PAPER A.

**A MANUAL OF MILITARY TELEGRAPHY FOR THE SIGNAL SERVICE.
UNITED STATES ARMY, EMBRACING PERMANENT AND FIELD LINES:
PREPARED UNDER THE DIRECTION OF THE CHIEF SIGNAL-OFFICER
OF THE ARMY.**

INTRODUCTION.

This work is, as its title indicates, a manual of military telegraphy, and is intended merely to furnish to officers of the United States Army such information as will enable them to establish and maintain telegraphic communication between forces in the field or points covered by military operations, as between the center and wings of an army, or an army and its base of operations, including, of course, intermediate points in either case.

The Morse or American system of telegraphy is the one proposed, and no attention is paid to others. Two kinds of lines are described, but they differ merely in weight and size of material and equipment: one intended for continued use upon fixed routes, being the ordinary American line, and herein called permanent, and the other intended for use with moving columns, being composed of lighter materials, more simply equipped, portable, capable of being rapidly erected and as rapidly taken down, and provided with means of transportation, and a drilled force to handle it, denominated field-lines.

Sufficient elementary information is given to enable the student to understand the principles which underlie the work he has to perform, without attempting a scientific treatise, and technicalities have been avoided as far as seemed practicable. Reference is made to works on electric and telegraphy for information of a character too purely scientific to be embraced in this manual, chiefly to the *Modern Practice of Telegraphy*, by F. L. Pope, esq.

The two varieties of lines are treated of separately, and each in the same manner: materials of line, method of preparation, tools for and method of erection, equipment, method of working, and, in case of field-lines, drill of the force.

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PART I.—PERMANENT LINES.

CHAPTER I.

Materials for permanent lines are :

First, supports ; which may be considered as of three kinds only, viz, posts or poles, growing trees, and buildings ; the first-named to be used whenever practicable, the second to expedite matters in building a line, or upon a route where timber of the proper size for posts is difficult to procure or transport, (as in forests where are no roads or bad ones,) and the third in cities or towns where it is not desirable to set posts in the streets.

Posts should be of such timber as is best able to resist decay, such as red cedar or black locust, either of which, if of proper size and well seasoned, can be expected to last from thirty to fifty years ; and, failing these, of white cedar, spruce, white oak, chestnut, sassafras, yellow pine, or cypress, all of which may be made to last well, say from ten to fifteen years. In emergency, and for lines not expected to last for more than two years, almost any timber will answer ; even cottonwood can be used for one year. White cedar, spruce, and sassafras are desirable material, being, when seasoned, extremely light and enduring well.

Posts should be the bolls or stems of young trees, straight, free from large limbs, at least 25 feet in length, and not less than 5 inches in diameter at the top, or small end. They should, when practicable, be cut and the bark be removed six months or more before they are used, to allow them to season, and this is urged for the double reason that such preparation adds greatly to their endurance when in position in line and reduces the labor and cost of transportation and erection. They might be still further guarded against decay by injecting their substance with any of the substances which have the property of coagulating the albumen of the wood, such as carbolic acid, the solution of the sulphate of copper, or others, but the exigencies of military service will seldom permit the delay necessary for these processes.*

Where posts such as have been described cannot be had, others may be sawed from large timber, and in this case, the sap-wood being removed, the posts will not decay so rapidly during the first year or two, and may be made somewhat smaller. For sawed posts, 25 feet long, 6 inches square at the butt, and 6 by 3 inches at the top, is a good size.

When trees are to be used as supports, care should be taken to select, if possible, such as have but few limbs, and those at a height from the ground exceeding that to which it is desired to raise the line, and sparse foliage or small tops, such being less liable to be moved or thrown down by high winds. In open country, where trees are used, it will be well to trim them very closely, for the purpose of reducing the surface exposed to the wind. A tree-insulator should always be used upon trees, which will be described in its place.

When it is necessary or desirable to use buildings as supports, the line should be run over their tops, resting upon as few supports as possible, and great care must be taken to attach firmly and insulate well. These are the least desirable of all supports, and rules can scarcely be laid down for their use. The builder must apply general rules, and exercise great care, as lightning-rods, metallic roofs, gutters, water-conductors, and many other such dangers are in his route, and must be avoided or guarded against.

Secondly, insulators ; and upon the quality of these depends the working of the line. By insulation is to be understood the severing in any manner the electric connection between the wire of the line and the earth, except at points where such connection is purposely made, in order that the current be compelled to flow in the wire. This end is to be attained by attaching to the support some non-conducting body, to which the line-wire may be attached.

Strictly speaking, there are no non-conductors, but those substances which are enumerated as such are the worst conductors, and are usually spoken of as non-conductors. (See Pope's Modern Practice, page 10.) Such non-conducting bodies are in number many—glass, and all vitrified substances, the resins, dry woods, oils, and all cereous substances, silk, cotton, &c—but from the list we may select two classes, vitreous substances and resins, as applicable to the purpose, the others, either from their becoming partial conductors when wet, as wood, flax, silk, &c., or from their fluidity at ordinary temperatures, as oils, &c., being valueless, or nearly so. Glass is the substance usually depended on, and its almost universal adoption by telegraph-builders is evidence of its superior practical value. Either simple, or as covering earthenware or porcelain, it is the substance in common use wherever telegraphs have been built, except in subterranean or submarine lines.

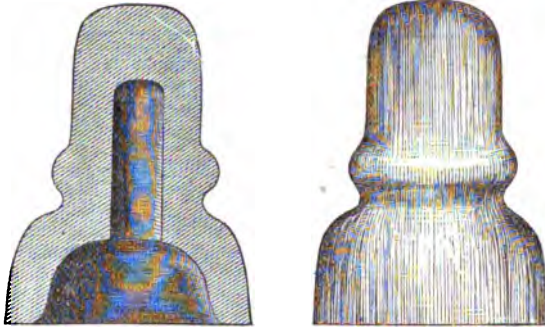
One form of insulator is shown by fig. 1. It consists of a glass cap 4 inches in height, $1\frac{1}{4}$ inches in diameter at and for $2\frac{1}{4}$ inches from the top, and of a bell-shape below, so that the diameter at the bottom is 3 inches. The glass is one-fourth of an inch in thickness. A bead or projection, one-eighth of an inch wide and high, at about one-fourth of an inch above the swell of the bell, forms a seat for the wire and prevents it from being slipped over the top of the insulator.

This may be attached to the posts by a pin in the top of the post, as shown in Fig. 2, or to

* For description of the processes for injecting posts, see Shaffner's Manual, pages 681 and 682; Sabine's Electric Telegraph, page 183 ; or Prescott, page 258.

the side, as shown by Fig. 3, or by a cross-arm, as shown by Fig. 4. In either case the glass cap should be made to fit the peg or bracket snugly, so as to be not easily removed, and a good plan is to have the peg or bracket made slightly smaller than the cavity in the glass,

Fig. 1.



and make the fit by layers of cloth (old tent-cloth will answer) which have been dipped in white-lead and oil. This preparation, when dry, cements glass and wood so firmly that, when the glass is broken by violence, the fragments are often held in place, and so a partial insulation secured. When the peg is used in the top of the post, it should be secured against decay by the same expedient, or some other which will prevent the water which falls upon the top of the post, or any portion of it, from finding its way into the hole in which the peg is driven. The bracket is secured to the post by nails or spikes of a size sufficient to hold it firmly, and the post should be flattened to make a seat for it. Brackets should be of white ash or oak, one foot long from point to point, cut from $1\frac{1}{4}$ -inch plank, wedge-shaped, as shown by the figure, 1 inch wide at the lower point and $2\frac{1}{4}$ inches wide at the shoulder. The peg or stud on which the insulator is placed should be

Fig. 2.



Fig. 3.

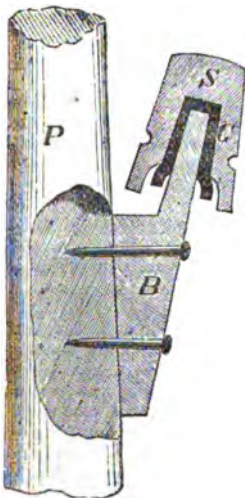
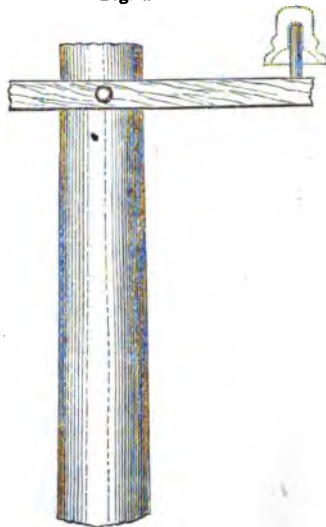


Fig. 4.

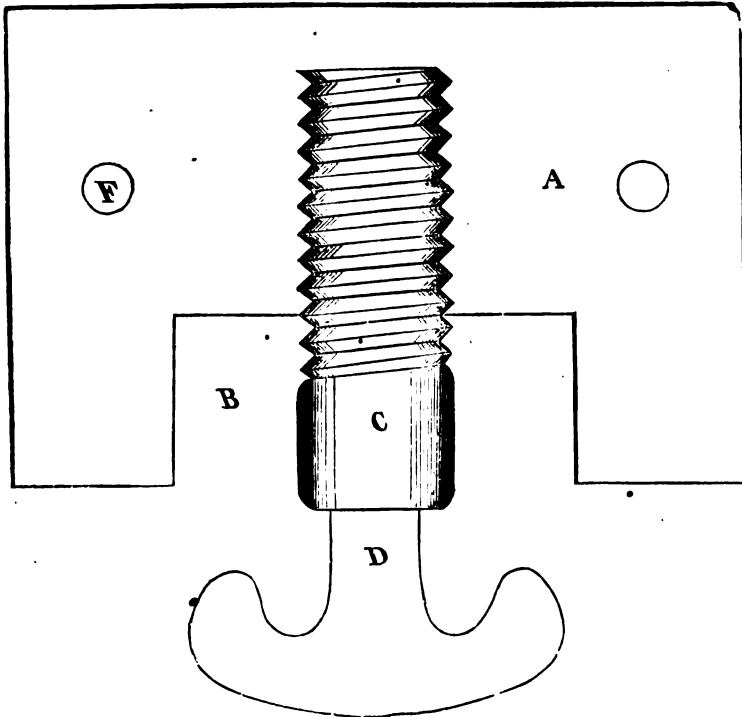


turned true, of a size to fit loosely in the insulator, and of a length sufficient to lift the edge of the bell 1 inch above the shoulder of the bracket. Two holes should be bored through the bracket to admit the spike, one at a point two inches below the shoulder, and the other at one inch from lower end, and both should be bored at right angles to the surface of the bracket which is in contact with the post. When cross-arms are to be used, a seat should be cut in the post, a hole bored for the bolt, and the cross-arms secured in position before the post is erected. If bolts and nuts are not at hand, and not easy to procure, cross-arms may be secured to the post by spikes; it is a question of economy, the bolts enduring longer than the spikes.

Insulators may be of glazed earthenware or porcelain, made in substantially the same form as those of glass, and such have been extensively used in Europe, but American telegraphers have not found them profitable, and few are now used. A very convenient form of insulator has been and is used, shown at Fig. 5. It consists of an iron stem, terminating in a cross, the extremities of the arms of which are bent at a right-angle with the cross, and

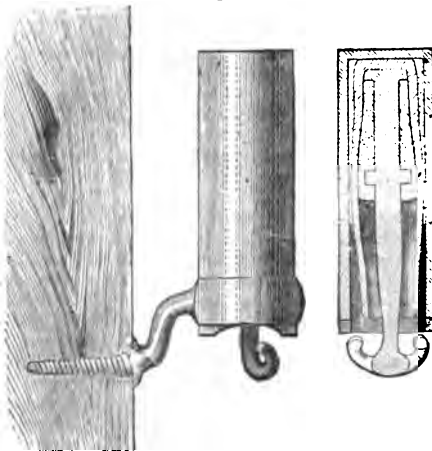
parallel with the axis of the stem. The other end of the stem, which is about six inches long, is covered for four inches with hard or bone rubber, (so called,) moulded into a cylinder, tapering slightly toward the end of the stem and closely embracing and adhering thereto. On the outer surface of the rubber a screw-thread is cut, and the insulator is screwed into a

Fig. 5.



hole bored in the under side of a cross-arm, or of a pine block, spiked to the side of the post, by which it is intended to protect the rubber from moisture. This insulator is strong, cheap, and durable, but it has not been found practicable to exclude moisture so as to preserve the

Fig. 6.



rubber in its best state, and when its surface has become roughened by exposure its value is much reduced.

Paraffine is almost entirely devoid of conducting power or capacity, and is, therefore, in that respect, a desirable substance for use in insulation, but its physical characteristics make the problem difficult of solution. One form of insulator which depends upon this material for its value is shown at Fig. 6. It consists of a hollow cylinder of cast-iron, closed at one end, and having an iron stem, like that described in the preceding paragraph, cemented in its center and projecting beyond its open end. The cement used is composed of non-conductors, one of which is paraffine, and the exposed portion of the stem, the surface of the cement, and the inner surface of the iron cylinder are thickly coated with paraffine. This form is costly, but bears a good reputation, and can but be effective if carefully made and used. It may be attached to the poles by being inserted in a hole on the

under side of a cross-arm or block, like the bone-rubber hook, or the iron shell may be furnished with an arm to screw into a hole bored in the pole.

Another form is that of an earthen cup, strong enough for the purpose, shaped so as to be used in the same manner as the glass insulator heretofore described and saturated through its entire substance with paraffine. This form has not yet been proved, but would seem a good one for climates in which the heat of summer is too feeble to melt the insulating material.

To all the forms of insulators heretofore described the line-wire is firmly attached, but, as this is not desirable where trees are used as supports, the motion of the tree endangering the continuity of the wire or the attachment of the insulator, or both, a form has been extensively adopted and used for service upon trees which consists of a block of glass, three inches long by two inches wide and high, having projections at each end on three of its sides, and a groove or slot an inch deep traversing its long diameter on the side on which no projections occur. This insulator is attached to a tree by being fitted into the top of a bracket and the bracket spiked to the tree. When in use it sustains but does not confine the wire, (which merely lies in the groove,) and the glass is protected from wet by a wooden cap nailed upon the bracket. This insulator may also be used on cross-arms by mortising the arm near its end to receive the glass and using the cap. As will be seen, it is not well protected against moisture, and is, in that respect, defective.

As expedients, in the absence of any accepted form of insulator, any non-conductor, so disposed that the line-wire shall come in contact with it and with nothing else, will answer. During dry weather seasoned wood, especially if saturated with resin, may be made to support line-wire, and signals have been successfully transmitted over fifty miles of wire so insulated.

Thirdly. Wire for permanent lines should be of best charcoal-iron, No. 8 standard gauge, though for military uses, having in view saving of weight and facility of putting up, No. 9 or No. 10 may be used for lines of not more than one hundred to two hundred miles in length. It should be annealed, coated with zinc in the manner known as "galvanized," joined up in half-mile lengths, the joints soldered, the lengths run into coils eighteen inches in diameter inside and six inches wide on the face of the coil, and the coils secured by four tie-wires equidistant from each other.

Such wire should show no sign of fracture after being bent, when cold, to a right angle and again straightened, should be free from slivers and splits, and weigh (No. 10) 300, (No. 9,) 340, and (No. 8) 380 pounds to the mile-length.

The following are some of the qualities required by the English postal department for its standard wire:

1st. The wire supplied under this tender must be of the gauge known as No. 8, Birmingham wire-gauge, (diameter .170 of an inch.)

2d. The wire to be highly annealed and very soft and pliable, and to be galvanized. The wire must be capable of elongating 18 per cent. without breaking, after being galvanized.

3d. The wire to be entirely free from scales, inequalities, flaws, splits, and other defects, and to be cylindrical.

4th. No deviation greater than .005 of an inch either way from the prescribed diameter will be allowed.

5th. The whole of the wire to be passed under and over three or more pulleys or fixed studs, placed in such position in the plan indicated as shall, in the opinion of the engineer, admit of the quality of the wire, as regards freedom from splits, being sufficiently tested.

6th. The whole of the wire to be stretched 2 per cent. by machinery, and after being stretched to be coiled carefully, so as to contain no bends or indentations, but in all respects to resemble newly-drawn wire.

The coating with zinc is less important in dry climates than in moist ones, being intended merely as a protection against oxidation, and consequent reduction of the conducting capacity of the wire, but is inexpensive, makes the wire easier to handle, in that it wears the hands of the men who handle it less than the iron, and is of further value, in that it aids in making good connections, when line is broken and rejoined after being erected, by preserving a bright surface. This fact becomes of importance where lines are especially liable to damage, and unsoldered joints (made by repairers or patrols) are frequent, as is likely to be the case with military lines.

For that portion of lines which traverses buildings for the purpose of connecting with instruments located therein, or to reach the main batteries, in short, for all in-doors work, a copper wire should be used of a size sufficient to be equal in conducting capacity to the line-wire—say, for a line of No. 10 iron-wire, a No. 18 copper; No. 9 iron, No. 17 copper; No. 8 iron, No. 16 copper—and such wires always insulated by a covering of silk, cotton, or flax, or of gutta-percha, caoutchouc, or ballata. For ordinary in-doors use the silk, cotton, or flax covering is best, as the other materials named deteriorate rapidly in a dry air, becoming brittle and detached from the wire. For passing into and out of buildings, where the fall of water from the roof endangers the insulation of the line, it may be well to use the gums, or some of them, and renew the wires as often as may be necessary to keep them in a proper state of insulation; though by saturating the fibrous covering with shellac, or other resin, or better still with paraffine,* an equally good result may be obtained.

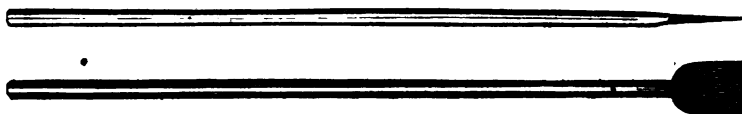
* PARAFFINE.—(*Parum*, little; *affinis*, affinity.)—There are several substances known in commerce under this name. It is usually applied to a white, solid, translucent substance, free from odor and taste, somewhat

Where copper wire is connected to iron, the joint must be protected by solder, or in some other manner, from moisture, or a local galvanic action will result, which will at the same time reduce the conductivity of the line, by oxidating the surfaces in contact, and impair its strength. If appliances for soldering are not at hand, the joint can be preserved by smearing it with a paste of white-lead and oil, of raw rubber, or by coating it with paraffine, each of which, however, yields to climatic influences, and is inferior to soldering.

CHAPTER II.

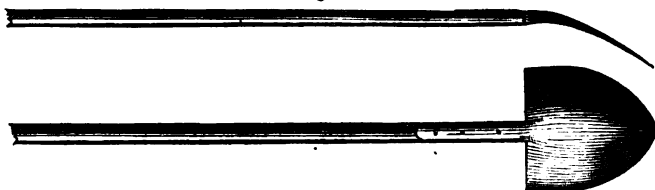
The tools and appliances for building a permanent line are few, and can be procured easily, most of them being found in any ordinary stock of hardware. There are, first: Axes for felling and preparation of posts, and for clearing the way for the line, where such work is required. Hatchets having a bit 4 inches wide, a head or poll with which to drive spikes, (and weight sufficient to make them effective in that respect, say 1½ pounds,) and hickory handles 15 inches long. This tool is of use not only in building but maintaining the line—is in fact one, as the pliers is the other, of the “line-men tools.” Diggers, (so called,) which

Fig. 7.



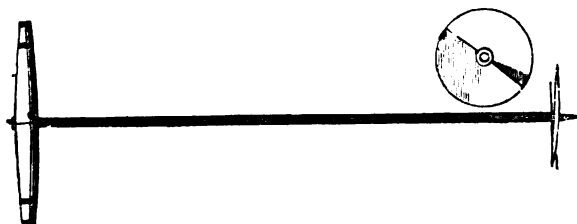
are crowbars of about 15 pounds weight, having a flat cutting point or edge, (Fig. 7,) for loosening the earth, and shovel, (Fig. 8,) for removing it, in digging post-holes, each being

Fig. 8.



of a length of not less than 5 feet, and the point of the diggers and blade of the shovels being steel. In soils where they can be used, post-augers (Fig. 9) should be provided in

Fig. 9.



place of bars and shovels, as on prairies, or alluvial bottoms free from gravel. With this tool one man can do the work of one and a half, using digger and shovel, and the hole may

crystalline in texture, of specific gravity about 0.87, melting at about 122° Fahrenheit, and volatilizing at a high temperature. It is but slightly acted upon by re-agents, hence its name. Its chemical composition is most probably that of a mixture of several hydrides of the higher alcohols, such as cerotene, or cerotic hydride, ($C_{27}H_{56}$) melene, or melenic hydride ($C_{28}H_{58}$) the lowest in this series being marsh-gas, methylic hydride (C_2H_6 .) Alcoholic hydrides, as they get lower in the series, become liquid at the common temperature, and are then known as paraffine oil. Paraffine is obtained in enormous quantities in the dry distillation of wood, coal, bituminous shale, petroleum, peat, and lignite.—*Rodwell's Dictionary of Science.*

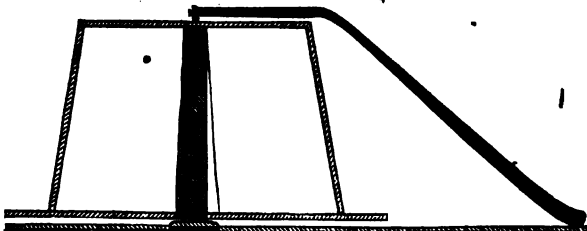
PARAFFINE.—Distill beech-tar to dryness, rectify the heavy oil which collects at the bottom of the receiver, and, when a thick matter begins to rise, set aside what is distilled and urge the heat moderately as long as anything more distills. Pyréline passes over, containing crystalline scales of paraffine. This mixture, being digested with its own volume of alcohol, of 0.833, forms a limpid solution, which is to be gradually diluted with more alcohol till its bulk becomes six or eight times greater. The alcohol, which at first dissolves the whole, lets the paraffine gradually fall. The precipitate, being washed with cold alcohol till it becomes nearly colorless and then dissolved in boiling alcohol, is deposited, on cooling, in minute spangles and needles of pure paraffine.—*Ure's Dictionary of Arts, &c.*

be made so nearly of the same size as the posts to be set therein as to greatly facilitate the erection of the line, saving labor of tamping, &c. Shears, foot-plates, and pikes for erecting and tamping-bars for setting the posts are also needed. The shears consists of two pieces of timber 6 feet long and 5 inches wide by 2 inches thick, (less will do if posts are not heavy,) crossed near one end, and firmly secured to each other in such a manner as to form a base 3 feet wide to rest upon the ground and a saddle upon which to sustain the weight of the post. The foot-plate is a curved plate of iron or steel, having a handle attached like that of a shovel. Its use is to receive the foot of the post while it is being erected and prevent it from loosening the material of the wall of the hole. The pikes are spruce, pine, or ash poles, 8, 10, and 12 feet in length and $1\frac{1}{4}$ inches in diameter, armed at one end with a spike and ferrule, and are to be used in raising posts. Tamping-bars are rammers of hard wood, 5 or 6 feet long, and of a size to be conveniently grasped. They are used to tamp or ram the earth about the post between it and the walls of the hole, in order that the posts may stand firmly when in place.

Augers for boring the holes in the posts for admitting the peg on which the insulator is set, or those through the post for the admission of the bolts used in attaching cross arms; saws, if the posts are to be prepared for the reception of cross-arms; wide chisels, to cut the seat for the cross-arm, and mallets.

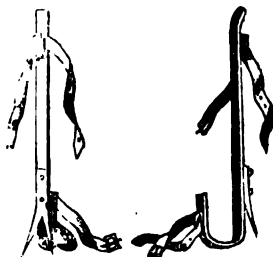
Reels, for laying or delivering the wire from the coil, shown at Fig. 10, consist of a base which may rest on the bottom of a wagon, the deck of a platform-car, (if the car is upon a railroad,) or other means of transportation, and the reel proper, resting upon this base and turning horizontally upon an axis. The base is a piece of timber 6 feet in length and 6 inches wide by 2 thick, having a cross-piece of like width and thickness and 4 feet long, halved on and firmly secured to it at 2 feet from one end. From the center of the point of intersection rises the axis of the reel. This is an iron rod $1\frac{1}{4}$ inches in diameter and $2\frac{1}{4}$ feet long. From the extremity of the long arm of the base an iron stay or brace extends to the top of the axis, hinged to the base, and engaging at the top with the axis of the reel, to prevent it from being bent or thrown out of perpendicular by any strain upon the reel. The reel itself consists of two pieces of oak or other hard wood, 3 feet long, 3 inches wide, and $1\frac{1}{4}$ thick, framed together at right angles to each other at their respective centers, having an iron plate on one side of the intersection, and through the center a hole for the admission of the axis. Secured to this cross, at such a distance from the center that the coils of wire to be used may drop easily over them, and connected at the top by another cross similar to the one described, except that its arms are shorter and do not extend beyond them, are four uprights of the same size and material as the crosses—the outsides of which are curviform—representing segments of the circle formed by the inside of the wire coils, and are 2 feet in length. When complete the reel is a skeleton of a frustum of a cone 2 feet in height, 18 or 20 inches in diameter at its base, and 3 inches less in diameter at its top. When in use it is upon the base described, is retained in position by the axis, and, revolving horizontally, delivers the wire from the coil placed upon and revolving with it straight and free from torsion, and so not liable to run into kinks if slackened or broken.

Fig. 10.



Pliers, for making connections in the wire, should be of the kind known as "flat-nosed," with a cutting blade on the side of the jaw, should not be less than 8 inches long, strong, and having well-tempered jaws. Files should be 8-inch triangular saw-files. The tool for making joints (or connections) in the wire should be of steel, 6 or 8 inches long, with one lip recurved. In use the recurved lip embraces the line-wire, while the shoulder rests against the end which is to be wound round and clasp it. By carrying the handle of the tool around the line-wire, the end will be snugly compressed upon and coiled around the line and a smooth joint made.

Fig. 11.



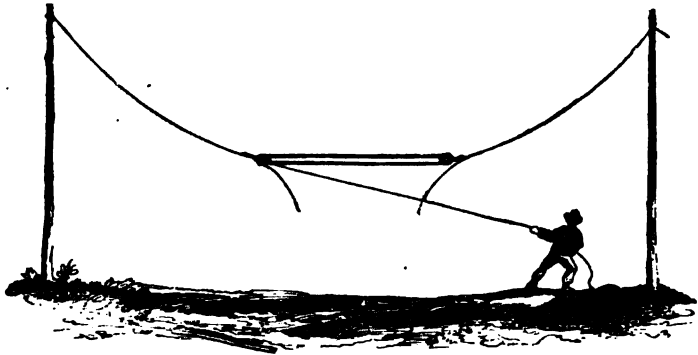
Tools for soldering joints are an alcohol-lamp of any convenient form, a bottle or other vessel containing muriatic acid in which zinc has been dissolved as long as the acid will take it up, and solder in bars of a foot or so in length and half an inch in width and thickness.

Climbers, to enable the men to reach the top of the posts easily, are of various patterns.

One or two well approved are shown at Fig. 11, as is also the mode of attaching them to the feet of the men.

Pulleys, for bringing together the ends of a broken wire, so that a joint or connection can be made, should be furnished. Two blocks, one single and one double, with not less than

Fig. 12.



50 feet of rope, form the set. Vises, or other devices for grasping the wire, are attached to the block-straps, which, together with the method of reeving, are shown at Fig. 12, and can be better understood by an examination than by the most careful description. In event of vises or other device for holding the wire being wanting, two ends of pliant rope, the bight of which is through the block-strap, can be made to grasp the wire with sufficient tenacity by winding them around it in long spirals in opposite directions and tying the extreme ends together to prevent the unwinding of the spirals. The blocks should be not less than four inches long, the sheaves of lignum-vitæ, and bushed with brass, and the rope best half-inch Manila hemp.

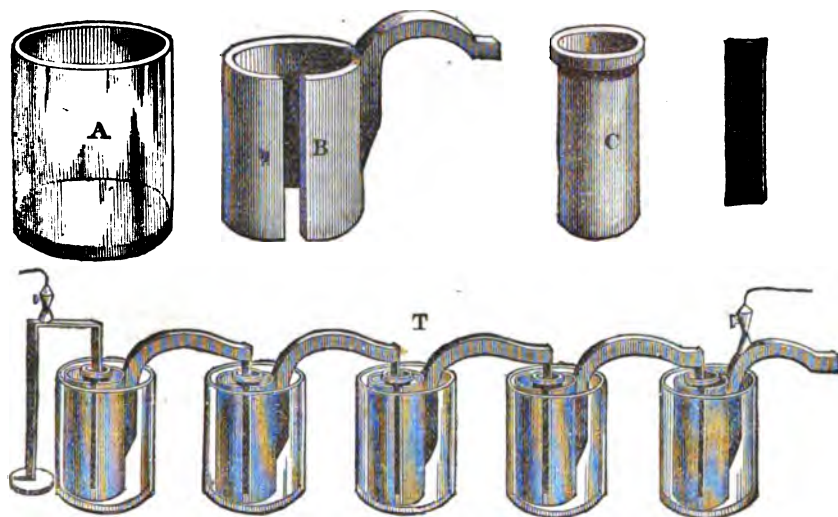
CHAPTER III.

EQUIPMENT OF A LINE.

For the equipment of a line there will be needed batteries, which are to the telegraph what the boiler is to the steam-engine, the source of the motor on which the action of the machinery depends. They are but various forms of the voltaic pile, and the principle upon which all are constructed may be thus stated: When two metals, one more easily oxidized than the other, are subjected to the action of water, a portion of the water is decomposed, the oxygen entering into combination with a portion of the oxidable metal, and a portion of the hydrogen being freed and escaping. At the same time a development of electricity takes place, positive or *plus* electricity being found at the less oxidable of the metals, and negative or *minus* electricity at the other. If the two metals are connected above the water by a metallic conductor, the metals exchange electricities over and along such conductor, and a telegraph-line, in miniature, is at once established. In developing the principle thus laid down it may be further stated that, the greater the difference between the metals and the more active the excitant, the greater will be the result in the development of electricity. Zinc is universally used as the positive element in batteries, being easily oxidable and inexpensive; but copper, silver, platina, and graphite are used as negative elements, and the excitants are almost numberless, varying from pure water to anhydrous acid. For *main batteries*, (i. e., those which supply the current that flows upon the line and serve as the means of communication between distant points,) one of the most approved forms is that shown at Fig. 13, called, from the name of its inventor, "Grove's." Its cell consists of a glass cup or tumbler, 4 inches in height, 4½ inches in external diameter, and of a thickness sufficient to give the requisite strength; a cup of porous earthenware, equal in height to the glass cup, 1½ inches in outside diameter at the bottom, and for 3 inches of its height having its top funnel-shaped, and 2 inches in diameter, and with its walls one-eighth of an inch thick. The material of this cup must be porous clay, and not vitrified, as it must be traversed freely by the electricity generated in the different cells of the battery or series. The zinc, or positive element, is in the form of a hollow cylinder, divided longitudinally, having projections or feet on which to stand in the cup, and an arm rising from its top above the cup and extending horizontally, so that its end shall be over the porous cup, in the next cell in the battery. The negative element is a strip or ribbon of platinum permanently attached to the projecting arm of the zinc cylinder.

The size of the zinc and platinum may be varied, but a convenient and effective size is $3\frac{1}{4}$ inches for the height of the zinc cylinder, and 3 inches for the horizontal length of the arm, both cylinder and arm being one-half inch in thickness, and the latter three-fourths of an inch in width.

Fig. 13.



The platinum strip for use with such a zinc should be three-fourths of an inch wide and 4 inches long and soldered firmly upon the end of the zinc arm. The exciting fluids are water and sulphuric acid, twenty parts by weight of the former to one of the latter, surrounding the zinc and filling the glass cup, and nitric acid surrounding the platinum in the porous cup.

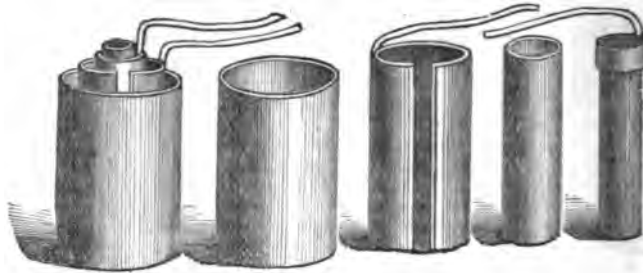
The action of this battery may be thus described: The series being connected one with the other and the extremities with the conductors, the oxygen of the acidulated water attacks the zinc, forming sulphate of oxide of zinc, which is dissolved as fast as formed, and thus is continued until the solution becomes saturated, when the oxide is deposited upon the zinc itself, and finally protects it from the action of the oxygen. The flow of electricity then becomes feebler, and finally ceases entirely. The hydrogen freed at the negative (platinum) plate is not permitted to escape or to adhere to the platinum, (by which the conducting power of the battery would be reduced,) but enters into the nitric acid, changing it from nitric to nitrous acid. This battery gives a very steady and powerful current, and is for that reason much used; it is, however, costly, and needs much attention to obtain the best results. The zincs should be amalgamated with mercury by being cleaned in a bath of sulphuric acid and water strong enough to boil them and then dipped in mercury. This preparation preserves the zincs from local oxidation, consequent upon impurities in the metal, and prevents the deposit of sulphate upon their surfaces. Fifteen cells of Grove's in good order are sufficient to work a line of one hundred miles in length, unless there is a large escape or leakage at some point on the line.

The Bunsen battery (Fig. 14) resembles the Grove in all except the negative element, which is of graphite or other form of carbon, instead of platinum. Its power is less than that of the Grove, inasmuch as the carbon is a poorer conductor than the strip of platinum, but it is cheaper, and therefore much used, especially on the continent of Europe.

The Daniells battery (Fig. 15) differs from those previously described in everything except the use of zinc as the positive element. It is less powerful than the Grove, and therefore less used in America, where long distances are to be traversed, but is much used in Europe, and is much recommended by its cheapness and the length of time it will remain in action without attention, deriving from this last peculiarity its name of "constant battery." A Daniells cell consists of a copper plate immersed in a solution of sulphate of copper and a zinc plate immersed in a solution (weak) of sulphate of zinc, or in water to which has been added one-twentieth of its weight of sulphuric acid. Its forms are very numerous and need not be described here. If the above-named conditions are maintained, the battery will work, and will give about half the force of the same number of Grove cells, (provided the strength of the solution of sulphate of copper is maintained,) until the precipitation of sulphate of zinc clogs the action upon that metal. A form of this battery, intended for military service, consists of a cylindrical copper vessel, the inner surface of which forms the nega-

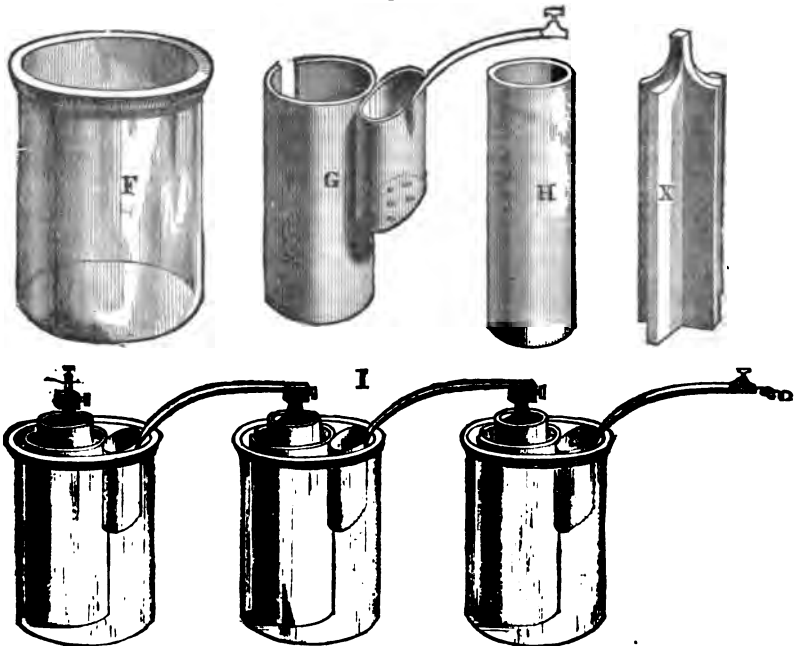
tive element of the pair, having a diameter of 4 inches and a height of 4 inches, with a perforated copper cup near its top to contain crystals of the salt, a leathern porous cup $2\frac{1}{4}$ inches in diameter, and of the same height as the copper vessel, attached to an insulated cover which fits the top of that vessel, and a prism of zinc 8 inches in height and $1\frac{1}{4}$ in

Fig. 14.



diameter. To place this cell in action, the copper vessel is two-thirds filled with a solution of sulphate of copper, (blue vitriol,) and the perforated chamber filled with crystals of that salt. The porous cup containing the zinc is filled with water slightly acidulated, or with a weak solution of sulphate of zinc, and placed within the copper vessel and the connections made. The solution in the copper vessel should fill it when the porous cup is in position, in order that the crystals in the perforated chamber may be dissolved.

Fig. 15.



When electric communication is established, the acidulated water attacks the zinc, as in other batteries, and the freed hydrogen finds an office in reducing the copper from the solution of its salt. The copper resulting from this action is deposited on the surface of the copper element, keeping it bright and preserving its conducting power. The weakening of the solution is prevented by adding fresh crystals as fast as those in the perforated chamber are dissolved, and the battery works with undiminished energy until the water in the porous cup becomes a supersaturated solution of sulphate of zinc, and a deposition of this salt takes place on the zinc itself. This battery has much to recommend it, its constancy alone making it everywhere preferred for locals. For military lines it has the merits of not requiring

the transportation of concentrated acids or such delicate manipulation as the Grove or the Bunsen.*

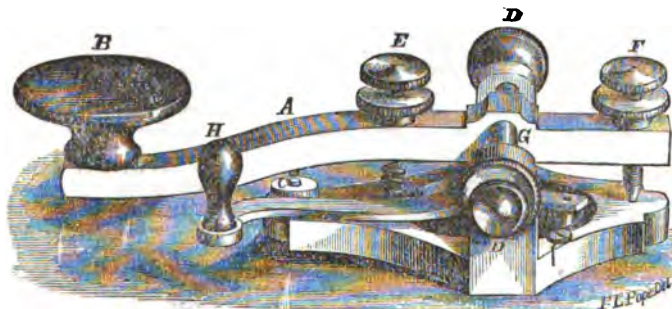
Other batteries might be enumerated and described, but the principles involved in their construction are substantially the same as in those already named. The necessary number of cells for any given line can only be determined when the character of the line as to conductivity and loss of current by defective insulation is known, but fifteen cells of Grove or Bunsen, or twenty-five cells of Daniells, are usually sufficient for a line of one hundred miles in length; and if that number of cells in fair order fails to give good results, the remedy should be applied in labor on the line, trimming, re-insulating, &c. For lines exceeding one hundred miles in length, one cell of Grove or two of Daniells, for each additional ten miles of line, should furnish a current of sufficient intensity. The Daniells cell is especially fitted for use as a local battery, two cells being sufficient for each office, or for each set of instruments where more than one is employed.

Main batteries should be as carefully insulated as any part of the line, the cells not allowed to be in contact with each other, and each one mounted on a dry insulating-stand. In one form of stand used the cell rests on the edge of glass strips so arranged as to shed moisture. The efficiency of this form is much increased by coating both wood and glass with paraffine. Another method is to make a battery stand by using an insulator with a flat top as a seat for each cell and attaching the insulators to a convenient support. The so-called Wade insulator, with wooden shield, is well adapted for this purpose. Local batteries do not need so much care in this respect, as the current generated by them is of low tension and the circuit offers little resistance; they should, however, be kept in a dry place.

INSTRUMENTS.

The instruments for equipping a line are the ordinary Morse key, relay, and sounder; switches, if more than one wire is used; and repeaters if more than one circuit is to be worked. The Morse key is a device for conveniently opening and closing the circuit, and is merely a brass lever of any convenient length, usually about 6 inches, having, about 2 inches from one end, a transverse axis or trunnion; at the end of the shorter arm a screw with a binding-nut for the purpose of regulating the distance through which the lever may move; at the other end a finger-piece, by which it is grasped, of ivory, rubber, or other non-conducting substance, and on the under-side a platinum stud. The lever is mounted by its trunnion on a base so that its set-screw shall be in contact with the base when the front end is raised, and the platinum in stud-contact with an insulated anvil, (also armed with platinum,) to which one end of the wire is attached when pressed down by the finger. The other end of the wire is attached to the metallic base of the key. A lever, held in its

Fig. 16.



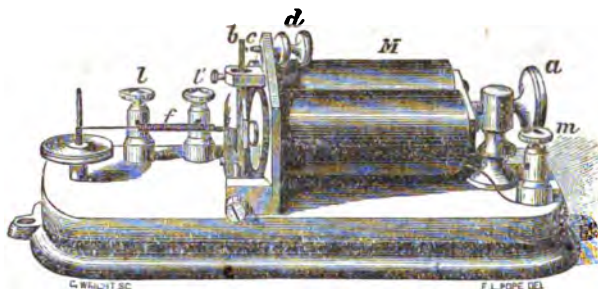
place by a spring, makes permanent contact, when desired, between the base and the anvil, and is called the "circuit-closer."

The key is held open when not in use by a light spring. An examination of Fig. 16 will enable the student to fully understand the apparatus.

*Note on the chemical action of the Daniells battery.—"When the current passes, the zinc is dissolved and the copper receives an equivalent increase in weight. In the chamber containing the zinc and acidulated water, the oxygen of each atom of water decomposed unites with an atom of zinc, forming an atom of oxide of zinc, which, in its turn, combines with an atom of sulphuric acid, forming sulphate of zinc, which is dissolved in the water. The atom of hydrogen released is transferred, by means of decompositions and recompositions, toward the copper cylinder. In the interior of the porous cup an equivalent atom of sulphate of copper is decomposed into one atom of copper, one of oxygen, and one of sulphuric acid. The atom of copper is deposited upon the plate by the current; the atom of oxygen, moving toward the zinc plate, meets the atom of hydrogen traveling from the other compartment of the element and combines with it, forming together an atom of water, while the atom of sulphuric acid goes to the zinc compartment to renew the supply there for the formation of sulphate of zinc, as that metal is dissolved."—*Sabine's Electric Telegraph*, page 222.

The relay (Fig. 17) is simply an electro-magnet of from five to fifteen miles' resistance, and fitted for use on a circuit of high tension, mounted on a flat base, and provided with convenient posts for the attachment of the main line and local wires, and with an armature

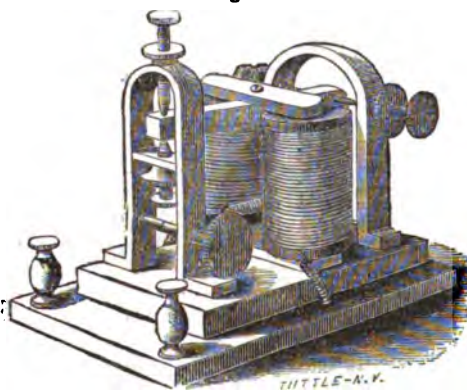
Fig. 17.



so mounted as to be opposite to and within the magnetic field of the poles of the magnet. This armature is provided with a spring, by which it is withdrawn from the poles when the circuit is broken and the attraction ceases. From the bottom of the posts *M* and *m*, connection is made with the wires of the magnet, so that when the line-wires are attached to the posts the magnet is contained in and forms part of the main circuit or route of the current generated by the main batteries. From the posts *l* and *l'* wires are connected with the frame-work that supports the poles of the magnet, and with the armature, which is insulated from the frame-work, so that the electrical connection between the wires can only be made when the platinum points, with which both the armature and the frame-work are armed, are brought into contact, this being part of the local circuit or route of the current generated by the local battery to work the sounder. Relays are of various patterns, but this general description will answer for all, as the principles involved and purpose to be accomplished are the same in all forms.

The sounder (Fig. 18) is also an electro-magnet, mounted conveniently, with armature, spring, connecting-posts, &c., like the relay, but differing from that instrument in the character of the magnet and the uses to which it is put. Its magnet is one of very slight resistance, and therefore fitted for use

Fig. 18.



only in a current of low tension, such as that generated by the local battery, (by which its action is controlled,) and repeats its signals so loudly as to render them distinctly audible, and thus reduce the difficulty of receiving or recognizing them.

Repeaters are a class of instruments rendered necessary by the difficulty of working circuits of more than two to three hundred miles in length, and are used to repeat automatically in a second circuit the signals made in the first by the manipulation of the key, each repeater performing the work of a receiving and a transmitting operator, thus reducing cost and the chances of error. They are of various kinds, and need not be described in this work, it being sufficient

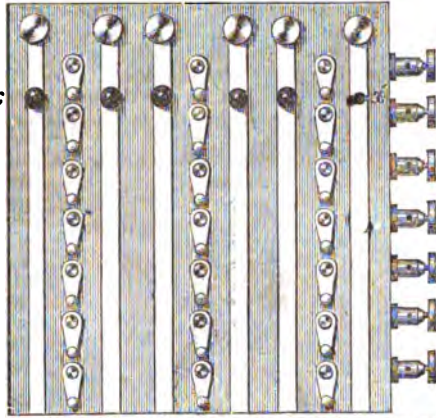
to say that all of them accomplish their purpose by making the armature of a sounder perform the office of a key in a circuit other than that in which the magnets of the sounder are connected.

Instrument-tables may be of any convenient form, and military lines will usually be roughly furnished in this respect, but a good form is 2½ feet in length by 1½ in breadth and 2½ feet high, with a drawer to contain stationery, &c. Such a table is large enough for a set of instruments and gives room for convenient copying of messages.

Switch-boards are needed where several wires enter an office, and are merely devices by which any instrument in the office may be connected with any line-wire, or, in case of an office intermediate between the terminals, by which line-wires on one side can be interchanged with those on the other. They are of various kinds, but the main features of all are similar. A board, having brass strips extending vertically across one surface equal in number to the line-wires to be attached thereto, with screw-posts at the ends of the strips, has also, between the strips, buttons hanging on pivots, (all of brass,) which pivots extend through to the back of the board, and are connected by a wire with one another in horizontal rows, and each row to a screw-post at the side of the board to which the wires which reach the instruments and batteries are attached. It will be seen that, when one of these buttons is turned to right or left, so as to touch a strip, the connection is complete from the line to

the instruments and batteries, and that, as each row of buttons crosses all the strips, it is practicable to make any connections desired. Various other convenient arrangements can be made, such as bringing battery and ground wires into switch-boards; arrangements for loops, by which an instrument placed elsewhere than in the office can be, at will, switched into any circuit on the board; tests made of wires, &c. The switch thus briefly described is known by American telegraphers as the "Culgan switch," (Fig. 19.)

Fig. 19.



Lightning-guards are devices by which atmospheric electricity, gathered by the line-wire, is removed therefrom and conducted to earth without injury to the apparatus or operators. They are of various forms, the object in all being to present near the line-wire, and between it and the instrument-tables, a route over which the atmospheric electricity can reach the earth, and this can be done readily, because that electricity will leap over or through short spaces without a conductor. One form brings the line-wire to a plate of metal having a serrated edge and a ground-wire to another such plate, the two plates being secured upon a base of non-conducting material with their points separated by a space not exceeding the one-thirty-second of an inch. Another is to connect the line-wire with a metallic disk and the ground-wire with another, the disks being pressed together by a gripe or clamp, but prevented from coming in contact by a disk of thin paper or of silk. In the one case the atmospheric fluid will leap through the air to the points of the plates attached to the ground-wire, and in the other burn its way through the paper or silk. All devices for this purpose must be carefully watched, as the passage of electricity through them will often melt a portion of the metal and establish a ground-connection, which will prevent the working of the line until removed.

In this connection, though not really part of the equipment of a line, it may be well to describe the manner of making ground-wires or connections. At stations where main batteries are to be kept, a good ground-connection is absolutely necessary to the successful working of the line, and should be made carefully. The ground-wire should be of copper, and should be equal in conducting capacity to all the wires which are to be worked from the battery, or rather should equal the conducting power or capacity of the battery itself. It may be connected by soldering to the water or gas pipes of a city or town; but if none such exist or are to be had conveniently, it should terminate in a copper plate having 6 or 8 square feet of surface, and buried in moist earth, below the reach of frost or drought. If the copper wire or plate cannot be had, iron wire and a plate of zinc may be substituted, or an iron wire may be led to and connected with a body of charcoal, or other form of carbon, buried as prescribed for the copper plate; but all such substitutes must be watched, especially the iron wire where it enters the earth, it being particularly liable at that point to oxidation.

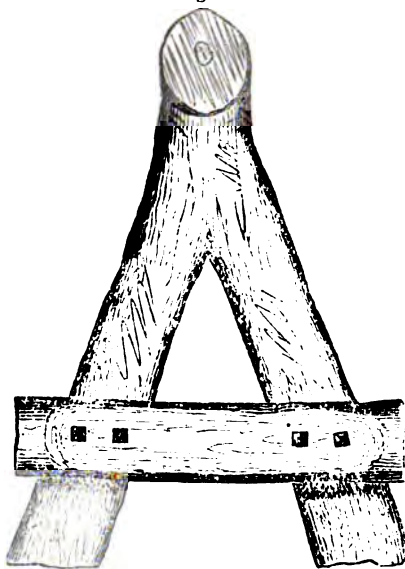
CHAPTER IV.

The labor necessary to build a line depends, of course, on the country in which it is to be built, the time allowed in which to build it, and, in short, the circumstances of each case, and much must be left to the discretion of the officer or person in charge. But a few suggestions may not be out of place; and first, the order in which the different portions of the work should be carried on. When a line is to be built and the route determined, a party or parties of not less than ten men, each in charge of a non-commissioned officer or foreman, initiate the work by digging the post-holes, the officer or foreman determining the places for the holes and seeing that they are properly made; the men working by twos, equipped with diggers and long-handled shovels or such other tools as the nature of the soil permits. Each of these parties should be accompanied by one or two ax-men to clear the way for the line by cutting shrubs and trimming or felling such trees as would obstruct or impede the work of erecting the line or impair its insulation by contact after its erection. Such a party should dig holes for four or five miles of line daily, making the holes four feet deep and seventy-five yards apart. This estimate supposes clay or loam in which to make the holes, and is,

of course, only approximate. For the subsistence of these and all other working parties proper arrangements must be made, but that is a matter which need not be entered upon here, as the same care would have to be taken of working parties at any other duty, and is simply commissary and quartermasters' work.

A party or parties to cut and prepare the poles should follow closely upon the diggers and should be strong enough to supply poles for the line as fast as the holes are dug. No rule can be given, the numbers of men and amount of transportation depending entirely upon the work to be done, the distance posts have to be transported, &c. Axes are the only tools needed. Wagons can be fitted for transporting poles by removing the bed or box and substituting a long reach for the ordinary one. If the ground be impracticable for wagons, posts may be hauled two or three at a time upon a contrivance shown at Fig. 20, which can be made on the ground by any handy

Fig. 20.



man. When the holes have been dug and the posts delivered for, say, ten miles, the insulators should follow and be attached, one man (or two, if more than one wire is to be put up) doing the work of attaching them, and the party which is to erect the posts should follow closely the insulators, erecting the poles as soon as the insulation is attached, in order that they may be out of the way of such accidents as would injure or destroy them if left upon the ground.

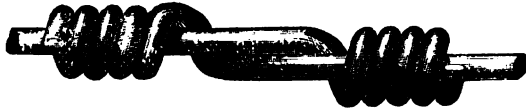
The number of men necessary in these parties will depend upon the size and weight of the poles, but cannot be less than five men and a foreman, and only so few when the poles are of very light wood, white-cedar, for instance, and well seasoned. For green posts, of oak, locust, or chestnut, ten men will be needed. In working the foreman or a man places the foot-plate in the hole on the side opposite to that on which the post lies; the men, seizing the post with their hands, raise its top from the ground breast-high and thrust its foot against the foot-plate; the man whose duty it is places the shears so as to support the post in that position, when the men quit their hold, and, taking their pikes, arrange themselves on opposite sides of the post, and, using their pikes, at once raise the post, which slips into the hole. This releases the foot-plate, which is removed; the cant-hook is applied and the post turned, if necessary, to the proper position, i. e., with the insulator on the side next the road, or the cross-arm (if any) at right angles thereto. Two men with shovels and tamping-bars fill the hole with earth and ram it solid; then the post is ready for the wire. In this, as, in fact, in all parts of the work, no pains should be spared to make the work thorough. The foreman must see that the posts are perpendicular; that the insulation is properly attached and in proper position when the posts are erected; that the holes are filled and the earth well rammed, and the surface of earth in contact with the post higher than that surrounding it, so as to turn the water away from it.

The wire-party should consist of foreman and six men, with a wagon (or, on railway, a truck) to carry the wire and wire-reel. The wire being in the wagon and the reel in place, the wire-man places a coil upon the reel, cuts the tie-wires, passes the end (taking care that it be the outside end) of the wire to the follower, who attaches it to the first post or such other starting-point as may be designated, the driver starts his team, and the wire is drawn from the reel, the wire-man applying so much friction to the wire or reel (by a clutch or brake) as may serve to give the wire proper tension; the follower, at from thirty to forty yards in the rear, carries the wire to the foot of the pole, and the climbers, four in number, carry the wire to the top of the post and attach it to the insulator, each man taking the fourth post from the one with which he starts. If more than one wire is to be put up, such a party will be needed for each wire, and the first party will put its wire on the insulator farthest from the route, that is, on the end of the cross-arm away from the road, or the insulator on or nearest the top of the post, so that the work of the first party shall not be in the way of the second. The foreman must see that the wire is delivered with only so much slack as is necessary, and does not hang too low when put up; that the joints or connections are properly made, and generally that the work is well and promptly performed. In putting up two wires on one line, the two parties can be kept within one-fourth of a mile of each other, and under the charge of the same foreman or officer.

Connections, joints, or splices, variously so called, may be made in any manner which will give a contact equal in area to a cross-section of the conducting-wire, so that the conduc-

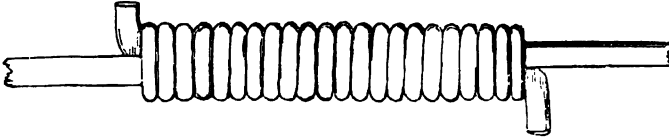
tivity of the line shall not be less at that point than where the wire is continuous. The connection in common use is shown at Fig. 21, and is made by bending the ends of the two

Fig. 21:



lengths around the other wire in a close spiral. Another form that has been a favorite with some constructors is made by winding the ends of the two lengths around each other in long spirals which interlock. A third, used in England and the provinces, and called the "Britannia joint," is shown at Fig. 22, and no description is

Fig. 22.



necessary. The joint first shown is, all things considered, the best for military telegraphs. The wire of a joint should always be cleaned, and, when practicable, the joint soldered.

CHAPTER V.

The line being erected, the maintenance thereof must be at once cared for, and the force necessary for this purpose must be determined by the circumstances of the case. No rule can, therefore, be given. Repairmen or patrols must be located at an office in order that their operations may be directed by the officer or person in charge from any point where he may be; must be mounted, or provided with other means of rapid transportation, and be equipped with hatchet, insulators, pulleys, and rope, or other device for bringing together the ends of a broken wire, climbers, file, pliers, and a small quantity of line-wire. Immediately upon the discovery of a fault, the repairman on either side of its supposed location should proceed at once in its direction, and go until he finds and repairs it or meets the man from the opposite side of the fault. In addition to this duty, the repairmen should have charge of a certain length of line, and should go over it often, replacing broken insulators, if any, trimming away branches of trees, shrubs, or climbing-vines, (in short, preserving the wire from any contact except with insulators,) and generally maintaining the line in good condition. On long lines this work should be under the care of a chief, who should be an operator capable of working and testing a line, who should be held responsible for the proper condition of the line at all times and be required to make proper reports of all work done under his direction.

The working of a line should be the duty of a superintendent, with as many assistants as there may be circuits in the line, if more than one, and as many operators as the business to be transmitted renders necessary. At offices that are to be kept open during the day only, and where a small amount of business is to be transacted, a single operator only is needed; but where the labor is continuous, eight hours a day is as much as a man can do and do well, and this should be broken into two watches or tours. Such lines will necessarily be worked by some of the usual modes, and are treated of as worked on the Morse plan, as the most flexible, requiring the least machinery and equipment, and the skilled labor for which is the most easily procurable.

The superintendent is of course responsible for the working and maintenance of the whole, each assistant to him for so much thereof as shall be his charge, and the manager of each office to his immediate superior for his office and subordinates. A system of reports should show monthly the state of the line, condition, property received, expended, and on hand, labor employed, rate paid, work done, and, if money received, its amount, from what sources, how disposed of, and such other information as may be necessary or desirable.

Where military operations are carried on along a line of railway, telegraphs will always be needed to facilitate the operation of the railway as well as to maintain communication between the force and its base, and to render the service effectual a single officer should have control of the movement of trains and charge of the railway wires, if practicable.

On military lines, the communications of the commander, or those addressed to him on military business, must have precedence over all others, those of subordinate officers next, and private or ordinary communications, if transmitted at all, must go only when the line is not otherwise occupied, and should be subjected to rigid scrutiny to prevent the transmission of intelligence of an improper character. When a railway is used, and no wire is set apart for its exclusive use, the messages of the master of trains or transportation concerning the

business of his office, affecting, as they do, the movement or supply of the Army, are of great importance, and take precedence of all except those of the commander of the forces.

The alphabet or code to be used on these lines may be that hereafter described; but, as the amount of business to be transacted will always be large, it may be necessary to employ skilled Morse telegraphers and use that code. For information concerning it and the best method of acquiring skill in its use, the student is referred to the work so often referred to already, the *Modern Practice of the Electric Telegraph*, by F. L. Pope; to *Wood's Plan of Telegraphic Instruction*, and *Smith's Manual of Telegraphy*.

PART II.—FIELD-LINES.

CHAPTER VI.

The materials for a line of field-telegraphs (by which is meant a line to be used in the presence of an enemy and for the purpose of placing the commanding officer of a force in constant communication with all parts of his line) differ from those for permanent lines chiefly in point of size and capability of being quickly erected and put into use and as quickly removed when the occasion for the line no longer exists. These materials must be, therefore, such as can be transported with the troops, handled by enlisted men, and when in line worked by enlisted men or officers.

The supports for a field-line may be either natural—such as trees—or artificial poles or lances. The use of the former should be guided by the same rules as for permanent lines, the circumstances being the same. The artificial supports must be of such size and weight as may be transported, and at the same time have length sufficient to carry the wire above the reach of mounted men or wagons and strength enough to endure such handling as under the circumstances they would be likely to receive, as well as to bear the weight and strain of the line-wire. To meet these requirements they must be made of a material at once light and elastic, and the timber best adapted seems to be spruce or cypress, either of which, when well seasoned, fulfills very nearly these conditions. The size may vary within certain limits, but that adopted in the field-telegraph trains of the United States Army is 17 feet long, $2\frac{1}{4}$ inches diameter at the butt, and $1\frac{1}{4}$ inches diameter at top, the butt tapering to a blunt point and the top secured by a sheet-iron ferrule 3 inches in length. Such a lance, of cypress, weighs about eleven pounds, and of spruce a trifle less, and two hundred and fifty of them, together with insulation for ten miles of wire and tools for the erection of a line of that length, can be carried on a truck made for the purpose and readily handled by six mules or four horses. A field-line should be supported by forty such lances to each mile of wire, but in emergency, or upon favorable ground, this number may be reduced to thirty-five or even to thirty without serious difficulty resulting.

In the matter of insulators for field-lines there is small room for choice. Glass and porcelain, the substances in common use for permanent lines, are unfit because of their fragility; the common resins, paraffine, &c., are unfit because of the difficulty of applying them, and there remain only the gums, caoutchouc, gutta-percha, and ballata. Of these gutta-percha becomes friable when long exposed to the sun, rain, and wind, and in such condition loses its good qualities; its use, therefore, is precluded. Ballata is not well proved, and no preparation thereof is yet offered which has consistence enough for the purpose. Caoutchouc when raw becomes viscid and loses form under summer temperatures, but in the prepared form known as vulcanite, ebonite, or, more familiarly, "bone-rubber," resists any heat less than that of boiling water, and has strength and consistence enough for the purpose, at the same time retaining to a great degree the non-conducting power of the raw or unmanufactured gum, making it the most desirable material for insulators for this service.

The form of the insulator is a matter of choice, two conditions only being of importance—that the outer surface shall shed rain and that there shall be an inner surface which shall remain dry, in order that there shall be between the wire of the line and the lance (which, when wetted by rain, becomes a partial conductor) a non-conducting surface. This can be obtained only by protecting a part of the surface of the ebonite from moisture, which, if allowed to reach it, forms a film over its surface and acts as a conductor. The formation of this film may be at least partially prevented by occasionally dipping the ebonite insulator into melted paraffine, the coating of that substance which the ebonite receives acting to prevent the formation of a continuous film of moisture, breaking the water into drops, at the same time that it preserves the surface of the ebonite from "weathering," and so acquiring a spongy character favorable to the formation of the water-film.

Various forms or patterns have been used, one of which was a simple cap of flexible vulcanite to fit over the top of the lance, both lance and cap having a cleft in which the wire rested and was secured by being wound around the outside of the cap; another, which consisted of a wire suspender or "clamp" of ebonite armed with a gimlet-pointed screw, by

which it was affixed to the lance or other support; another consists of a spike, which passes through the top of the lance or is driven into a tree, and a suspender formed in part of ebonite. Each has merit, but neither gives entire satisfaction. It would seem evident that the fewer parts the insulator consists of, the better, as less liable to become useless by fracture; that the insulator should be readily attached to and detached from the lances or other supports, and that the device for grasping the wire should be such that the wire could be easily placed therein and not readily displaced, and be held without bending.

Substitutes for any regular form of insulator can be made from many materials, and the ingenuity of the officer must be his reliance. The non-conducting properties of bodies being known, he must make use of the best within his reach, and turn it to such advantage as he may. An insulator of "fat pine," or any wood saturated with resin, may be made to answer a good purpose while the saturation continues. Loops of cotton, linen, or silk fabric suspending the line-wire will insulate it sufficiently during dry weather, and if saturated with oil will prove efficient on a short line even in rain or fog. Saturation with paraffine would be more effective than with oil, and a quantity of this substance might be comprised in the list of supplies for a field-train with much propriety. Wire for field-telegraphs must be light, flexible, and strong enough to bear a tension which will reduce the deflection or "sag" between lances 70 yards apart to 2 feet. Iron is the only material which answers the purpose at moderate cost, and an iron wire, drawn from charcoal rods to No. 15, American gauge, has been adopted for use by the United States. A mile of this wire, joined up and the joints soldered, makes a coil 18 inches in diameter inside, 4 inches in height, and 3 in thickness, and weighing but 75 pounds. The American compound telegraph-wire, a patented article, consists of a steel core, with a coating of copper, and when drawn to No. 18 size has, when new, equal strength and greater conducting capacity than No. 15 iron wire, but is not well adapted for field-use, being less flexible than the iron, breaking more easily if bent, and deteriorating rapidly in consequence of the oxidation of the steel core, wherever moisture reaches it, which it can scarcely fail to do, as the copper coating or envelope opens to the steel whenever the wire is rudely bent or handled.

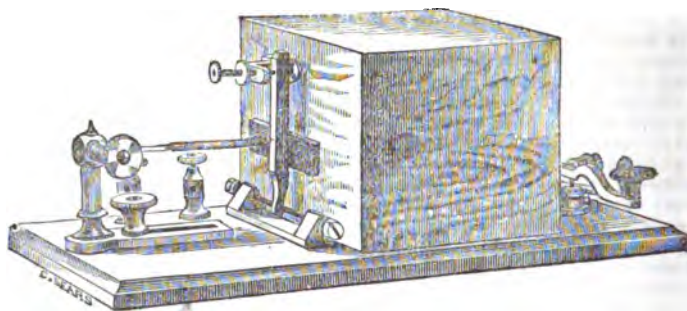
For use where, for any reason, it is impracticable or inexpedient to erect a line upon supports, and therefore necessary to lay it along the ground, conducting-wire must be provided which is insulated throughout its entire length. Such a wire has been referred to heretofore as "office-wire," but especial pains needs to be taken to provide for field use, and the various descriptions of such insulated conductors, their characteristics, method of manufacture, strength, flexibility, and conducting capacity understood. Copper, from its high conductivity, is the metal used, and is strengthened in various ways. One device is to form a conducting strand of five wires, the center one of steel, for strength, and the outer ones laid spirally around the center, of copper. Such a strand, made of No. 30 wire, will have the strength of a No. 14 iron wire and the conducting capacity of No. 8, or very nearly, and may be insulated in any manner, like a single wire. Kerite, a preparation of caoutchouc, not yet well known or proved by use, has shown valuable qualities under experimental tests, resisting the action of the atmosphere, which usually destroys such preparations, and is highly recommended by many competent telegraphers and electricians. A single copper wire, covered with a layer of hemp fibers laid parallel to it, and the whole with a spiral covering of cotton, (cotton and hemp being saturated with paraffine,) is light, quite strong, (sufficiently so to sustain itself in spans 200 to 300 feet long,) and sufficiently well insulated for ordinary use. The insulation can be kept up by occasionally passing the wire through a bath of melted paraffine. Another device for retaining the hemp fibers in place has been used by some manufacturers, viz, braiding flax around it, and a preparation of paraffine and coal-tar, known as "Bishop's compound," is used instead of the pure paraffine. For use under water, gutta-percha is the best insulating material known, improving when submerged, instead of deteriorating. For subterranean use the same can be said.

CHAPTER VII.

Instruments for field-lines must be simple, easily placed in position for use or removal, easily adjusted, and strong. Several varieties have been tested by the Signal-Office, but the one from which the best results have been obtained is a form manufactured by Messrs. L. G. Tillotson & Company, in New York, and known as the "box-sounder," shown in Fig. 23. Another form, known as the Caton instrument, shown in Fig. 24, consists merely of an electro-magnet mounted horizontally and provided with an armature, the vibrations of which, when attracted to the poles of the magnet or withdrawn therefrom by the tension-spring, give the sounds by which the signals are recognized; a key by which the circuit is opened and closed in signaling; a device by which the circuit is kept closed, except when the key is in use, and screw-posts by which to attach the line-wires, the whole contained in a case to protect it during transportation. The one shown in the cut is of convenient size, being about 6 inches long and 2½ in width and length.

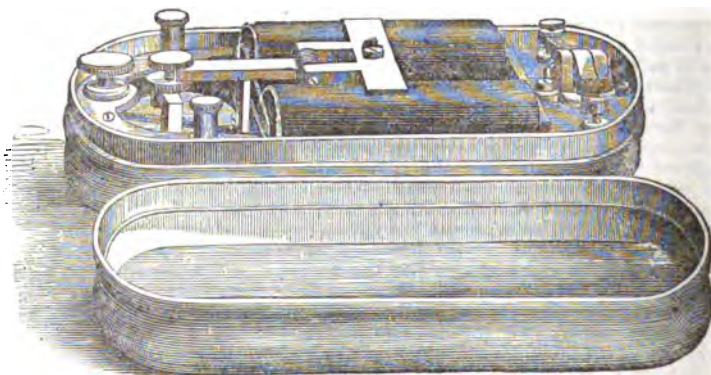
Batteries for field-use need not be so powerful as for permanent lines, and others which require the use of such powerful excitants as sulphuric and nitric acids, and must not be composed of glass or other fragile material. These conditions render the Grove and Bunsen batteries unsuitable and leave the Daniells only for use in some one of its various modifications. The form used at present by the United States Signal Service is an adaptation of the Daniells, and consists of a wooden trough divided into cells by wooden partitions, the whole

Fig. 23.



being rendered non-conducting and impervious to water by saturation with paraffine; a thin copper plate, near the bottom of each cell, having underneath it a layer one-fourth of an inch thick and above it a layer three-fourths of an inch thick of crystals of sulphate of copper; a sponge, saturated with water and filling the cell to within an inch of the top, upon the upper surface of which is sprinkled white vitriol, (sulphate of zinc,) and a zinc plate, which rests upon the sponge. The cells are 5 inches square, being the same in length, breadth, and depth; the top, bottom, and sides of the box or trough containing them, 1 inch

Fig. 24.



and the partitions between the cells one-fourth of an inch in thickness. The copper plates are $4\frac{1}{4}$ inches square and about one-sixteenth of an inch in thickness, and to each one is attached a copper wire, insulated with gutta-percha or caoutchouc, of sufficient length to reach the zinc of the adjoining cell. The zinc plates are $4\frac{1}{4}$ inches square and 1 inch in thickness, and are furnished with thumb-screws for connecting with the wire from the copper element of the next cell. The cover of the box or trough is hinged, and when closed is secured by hasps and staples. When closed and secured it presses firmly upon the zinc plates and prevents any displacement of the parts of the battery. It will be seen that this is substantially the Daniells copper-zinc pair, the sponge taking the place of the porous earthen cup and the trough or box that of the glass or earthenware containing-vessel. The superposition of the zinc prevents the copper solution from reaching it, and the battery so arranged works with little diminution of force as long as any of the crystals of blue vitriol remain undissolved. It is only necessary to add a little pure water from time to time, to supply the waste by evaporation or leakage. When the cell is filled 1 inch in depth with the crystals, it will work from forty to sixty days without renewal. When necessary to renew the battery, the materials must be removed, the sponges well cleaned, and the whole

replaced in proper position. The form of cell and arrangement of the different parts will be understood from Fig. 25.

Fig. 25.

Fig. 26 shows an adaptation of the Marie Davy cell to field-use. The containing-vessel is of ebonite and the cover screws on water-tight. The zinc is kept in place by studs that fit closely into the containing-cell, and into one of which a screw-post passes from the outside. The porous cup is of leather and is fastened to the cover. The negative element is carbon, a plug of which is fitted with a metallic head that screws into the cover within the porous cup. This cell is charged by filling the porous cup with a paste of the bisulphate of mercury and water and the outer cell with the water in which the paste was made. The action is similar to that of the copper-zinc pair, the oxygen of the water attacking the zinc and the freed hydrogen finding its office in reducing the mercury from its crystalline salt. It gives off no gas and works as long as any of the salt remains in the porous cup.

In the absence of any form of battery especially adapted for field use, any of those described herein can of course be used, and the ingenuity of the officer must be his reliance. The principal difficulty will be found in providing transportation for them, and this must be overcome in the best possible manner. The signal-service battery can be made roughly under almost any circumstances—out of a feedtrough, by putting in partitions and coating the inside with wax, tallow, pitch, or other non-conductor; out of a number of buckets, or, in brief, any vessel that will hold the elements. Cotton, tow, sawdust, spent tanbark, sand, or almost any porous substance may be substituted for the sponge, and the battery be made to answer a good purpose until others can be procured. The white vitriol is not indispensable, as the battery will work without it, only requiring a few hours' time to come to its full strength.

The ground-connections for a field-line are necessarily such as can be quickly made and easily removed. The most convenient form is that of a cylindrical iron bar, 5 feet long and 1 inch in diameter, pointed at one end and fitted at the other with a binding-screw by which to attach the ground-wire, the whole zinc-coated, (galvanized,) to prevent oxidation and to present always a bright surface to the earth. Such a bar, driven two-thirds of its length into moist earth, is a sufficient ground-connection for field-lines of thirty miles in length.

In cases where the earth at the station is so dry as to render the bar ineffectual, moist earth must be sought at a distance and the ground-wire run to it, or the earth moistened by pouring water into the hole made by the bar, the first-named method being preferable for the reason that the moisture in the second case will scarcely be carried far enough to remedy the defect.

Ground-connections may be made as for permanent lines whenever circumstances (loss of

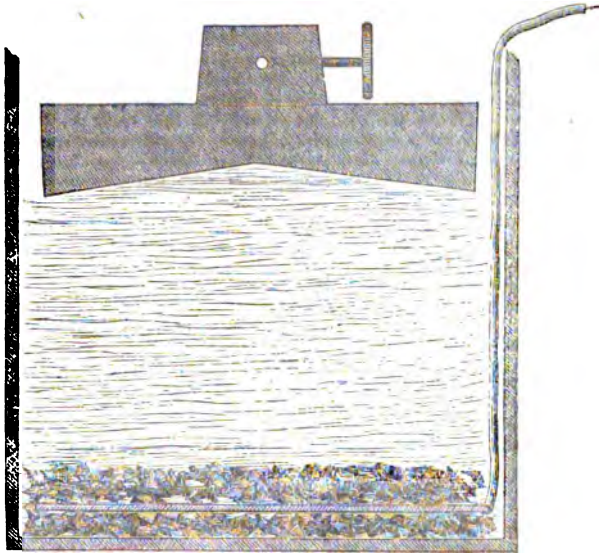
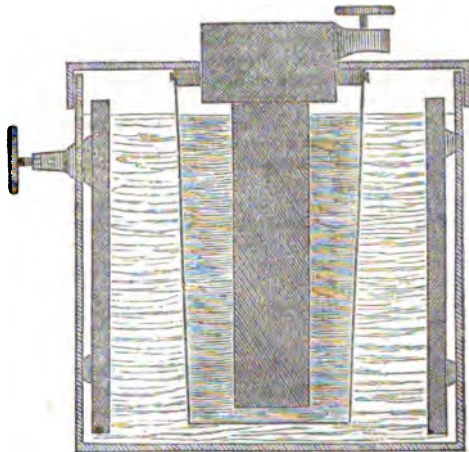


Fig. 26.



bars, &c.) may render it necessary or convenient to do so. The rule to be followed is the same in one case as in the other—a surface in contact with earth that shall equal in conductivity the battery and line.

The tools for the erection of a field-line (which constitute, with the materials for the line, the outfit of the train) are: marking-pins, by which the points of support are indicated; axes and hatchets, to cut away shrubs or branches of trees or to affix insulators to natural supports; crow-bars, to make holes in the earth in which to set the lances; bars, fitted for cutting through frozen ground; climbers, to enable the men engaged in the work to ascend trees, when necessary, for the purpose of affixing insulators thereto, or to trim away branches; reels, for the delivery and recovery (uncoiling and recoiling) of the wire; pliers, to be used in making connections; files and screw-connectors, which are to be used for making connections between the coils (mile-lengths) of wire in reeling out, and generally where connections are to be frequently made and broken, to avoid loss of time and waste of wire.

The marking-pins are of iron wire, one-eighth inch in diameter and 15 inches long, pointed at one end and having a loop or handle at the other, painted of some bright color, and fitted with a small pennon of bright-colored cloth, so as to be conspicuous objects, and are used to mark the places where lances are to be erected, by being thrust into the earth at such points, or the natural supports to which insulators should be affixed by the same methods.

It is scarcely necessary to describe axes or hatchets, except, perhaps, to say that the latter should have a hammer-poll with which to drive a spike. But the efficiency of the line may depend on their use, which is mainly to cut down all shrubs growing near the line-wire, to trim off such as come, or might be thrown by the wind, in contact with the line-wire.

Crow-bars, with which to make seats for the lances, are cylindrical iron bars $4\frac{1}{4}$ feet long, $1\frac{1}{2}$ inches in diameter for 2 feet from the point, and 1 inch in diameter for the rest of their length, and pointed so as to penetrate the earth easily. Such a bar weighs fifteen pounds. These (and all the iron used in the work) should be zinc-coated, (galvanized.)

Ice-bars are of the same general form and dimensions as the crow-bars, but have a wide chisel-shaped point or blade, and are used for cutting through frozen ground, to facilitate the work of setting the lances.

Climbers, to enable the men engaged in erecting a line to ascend trees to affix insulators and attach the wire, are of various patterns. A good form is made of steel, with leathern straps for attaching them to the feet, and weigh about four pounds the pair. A strap or sling is carried over the shoulder of the man and used to aid him in maintaining his position without the use of his hands, leaving them free for the work of handling his tools.

Reels for field use are in general form like those for permanent lines, but are lighter, and are provided with arms attached to the uprights, which are laid flush with the face of the uprights when reeling out wire, and secured at right-angles thereto when reeling up, in order to confine the wire and give the coil its proper shape. Each one has a handle affixed to the extremity of one of the upper cross-arms, by which it is turned when reeling up wire.

The reel is seated in the wire-wagon, but may be carried by men over ground impracticable for the wagons in the hand-bearer, one of which should accompany each reel.

Pliers and files are of the same kinds as for permanent lines, but smaller, as the wire is smaller and the work to be done lighter. Connectors are simply brass cylinders, perforated through their length to admit the wires, and fitted with a thumb-screw, the end of which presses upon and holds the wires so inserted.

CHAPTER VIII.

The vehicles used for the transportation of the materials, tools, and equipments are also used for offices or stations, and are called battery-wagons, wire-wagons, and lance-trucks.

The battery-wagon is the central or headquarters office; is of a size sufficient to contain four instrument tables, the necessary batteries for four lines, each ten miles in length, instruments and table apparatus for each table, four ground-bars, a supply of battery-material, seats for four operators, and a stove.

It is mounted on platform-springs, and turns in its own length, is covered with canvas, and must not be too heavy to be drawn by two horses over any ground practicable for artillery. The tables are each $2\frac{1}{2}$ feet long by 1 foot or 1 foot 3 three inches wide; are attached to the sides of the wagon at a height from the floor of $2\frac{1}{4}$ feet; one in each corner of the wagon. The batteries, in sections or cases of six cells each, are supported by brackets underneath the tables, each bracket being of a size sufficient to support two such sections. The instruments and table-apparatus are carried, when not in use, in pouches of leather attached to the sides of the wagon between the tables; the supply of battery-material in a box underneath the driver's seat; the ground-bars on the floor, next the sides, (two on each side,) and confined by clamps and keys; and the seats for the operators (camp-stools) in any convenient manner. The stove is placed in the center of the floor and secured against displacement. The wagon is entered by a door at the rear.

The wire-wagon is of the same general form as the battery-wagon, and mounted in the same manner. It is of size and strength to contain an instrument-table, which is attached to the front end; a single section of battery underneath the table; a pouch for instrument and apparatus at its side; a seat (camp-stool) for the operator; a ground-bar, secured as in the battery-wagon; a wire-reel, seated in a socket in the center of the floor near the hind end; a hand-bearer, secured at the top of the wagon by straps; ten coils of wire, (one mile in each,) secured for transportation at the sides of the wagon; and a box, which serves to hold the wireman's tools (pliers, files, and connectors) and as a seat for him when at work reeling out or recovering wire. This wagon must be strong to safely carry its load, but must at the same time be light enough to be handled by two horses on roads or ordinary ground, and by four over any ground at all practicable for wagons.

The lance-truck is a wagon without springs, of length sufficient to carry lances, and of strength sufficient to sustain the weight of 250 lances and all the line-tools and insulators for ten miles of line. The lances are stowed compactly in the middle of the wagon or truck and confined by upright stanchions and end-boards. The insulators and tools are contained in boxes arranged for the purpose on either side of the pile of lances. The weight of the load will be approximately 3,000 pounds, and a good six-mule team will be needed to move it. It carries 250 lances, 400 insulators, 16 crow-bars, 4 ice-bars, 2 axes, 12 hatchets, 12 pairs of climbers, and 80 or more marking-pins.

A full train consists of one battery-wagon, four wire-wagons, and four lance-trucks, and is divided into four sections, each of which consists of a wire-wagon and lance-truck and is capable of acting independently. Thus a full train may erect lines radiating in four directions from the battery-wagon; or the four sections, the second commencing to reel out its wire when the first has finished, may extend a single line forty miles long, having offices at the termini and at three intermediate points equidistant from each other. Additional instruments being furnished, intermediate offices other than the regular ones can be opened when ever necessary.

The train is commanded by a chief of train, whose place is with or near the headquarters of the force with which the train is acting, and with him the battery-wagon with its complement of operators, battery-man, and driver. To work the four lines separately twelve operators will be the ordinary number, three for each of the lines, giving to each eight hours' duty out of each twenty-four; and this should be divided into two tours or watches of four hours each. Should the work to be done by the lines be exceedingly heavy, this force might be increased to advantage, and under other circumstances might perhaps be reduced; but it is false economy to require too much of men, and eight hours of close attention is fully enough. The battery-man will have charge of and be held responsible for the batteries, not only those in the battery-wagon but also those in the wire-wagons; will see that they are at all times in order and ready for work; have the care of the supplies for them, and make regular reports to the chief of train, embracing all necessary information concerning them.

Each section will be commanded by a chief of section and manned by four non-commissioned officers and thirty-six men, whose several duties will be as follows:

One director, (non-commissioned officer,) who, receiving from the chief of section general orders concerning the direction to be taken or point to be reached, will go over the ground and select the route for the line. He will be accompanied by two markers carrying guidons, whom he will station so as to guide the surveyor. The director should be carefully selected, as upon his skill and judgment depends, in a great degree, the promptness with which lines can be erected. He must take the most direct line practicable to the point he has to reach, but, in order to determine what is best, he must examine the character of the ground and know that there are no obstacles insuperable to the train—streams, ravines, bluffs, or marshes; that the soil is such that the line can be erected—not loose sand or rocks; that the route he selects is not made impracticable by the guns of an enemy; and, in short, must bear in mind all the contingencies to which the train or line may be subjected, and be governed by the circumstances of the case. The director and markers must be mounted, and each marker, on being relieved from post by the arrival of the surveyor, will rejoin the director. Over difficult ground it may be necessary to increase the number of markers, and upon a road or over country well known it may be practicable to dispense with them entirely, the director accompanying or slightly preceding the surveyor. For night-work the markers will carry a lantern instead of a guidon.

One surveyor, whose duty it is to move toward the marker in sight, measuring the distance by paces and directing the pin-men where to plant the marking-pins. He will be governed by the general rules for locating lines as laid down herein, in which he should be thoroughly instructed. He is accompanied by three pin-men, two of whom have each forty or more marking-pins, which they plant at points indicated by the surveyor, to indicate the place where lances are to be erected, or insulators attached, if natural supports are used. The first man, when his pins are expended, halts until the third, who follows the lance-men, has gathered the pins and overtaken him, when he rejoins the surveyor, and the second on expending his pins does the same, the first and second relieving each other and the third bringing up the pins when the line is erected.

Thirteen bar-men, twelve of whom are equipped with a crow-bar, with which, at the points indicated by the marking-pins, they make holes for the foot of the lances. This must

be carefully done, and that it is so it is the duty of the thirteenth, who is a non-commissioned officer and chief of the detachment, to see. The holes must be fully 2 feet deep, which will be the case if the shoulder of the bar is below the surface when the point is at the bottom of the hole, and large enough to admit the lance easily. As the lance is of twice the diameter of the bar, the hole must be made of the proper size by working the bar around and pressing back the earth, and this should be done as the bar is driven down, for if the bar be driven first to the full depth and then worked, it will be difficult to sufficiently enlarge the hole in ordinary soils, and when done will not be of uniform size, but large at top and bottom, and smaller midway, a point to be avoided, as in such a hole the lance will be easily drawn from a perpendicular even if it can be forced to the bottom. The bar-man, standing erect, should grasp his bar near the top with both hands and drive it into the ground, working with hands close together, as, if he grasps the bar with one hand near the top and the other below, he will not work as easily or direct the blows of the bar so accurately, but will be compelled to bend his body sidewise, his upper hand will throw the top of the bar from him and the lower hand draw the point toward him; the work will be done in a slovenly manner, and the hole when completed not be perpendicular.

Two wire-men, whose duties are to accompany the wire-wagon and attend to the reeling out and reeling up of the wire. They will, in reeling out, place the coils of wire upon the reel, remove the straps or wires by which it is bound, and one of them, seated in the wagon, by the use of the brake so control the motion of the reel that the wire shall be laid straight and without slack, and will make the necessary connections as the coils are one after another paid out. Joints in field-wire should be made in the same manner as in wire for permanent lines, except that to join the end of one coil to that of another it is well to use a wire-connector, as these joints mark off the line into mile-lengths for convenience in recovering the line and recoiling the wire, and time is saved by their use. All joints other than these must be carefully made in the same manner as for permanent lines, and soldered. The second man will follow the wagon and carry the wire to the line of lances, and render such assistance to the first as may be required.

Thirteen lance-men (one of the number being a non-commissioned officer and chief of the detachment) will affix the insulators to the lances and deliver a lance and insulator at each hole, one or two men being mounted upon the lance-truck for that purpose, and the others will place the wire in the insulators, erect the lance, thrust its foot into the hole prepared for it by the bar-men, and stamp the earth solidly around it.

Three operators, to work the station when opened, and drivers for the wire-wagon and lance-truck, complete the force.

CHAPTER IX.

TRAIN DRILL—(ONE SECTION.)

The minimum force for illustrative drills with a section-train is as follows: One (1) lieutenant, one (1) director, one (1) surveyor, two (2) pin-men, seven (7) bar-men, two (2) wire-men, seven (7) lance-men, two (2) operators, and three (3) drivers.

It will be parked in the following order:

Wire-wagon in line with and ten (10) paces on the left of the battery-wagon, and the lance-truck in rear of the center of the wagons, with distance of ten (10) paces, as indicated in Fig. 27.* The figures refer to the illustrations of the train-drill given in the manual.

At the "first call" the drivers, director, and markers will saddle and harness up.

When the "assembly" is sounded the drivers will lead out and hitch up, the director and markers will lead out and take position immediately in front of the train, and with the drivers will stand at "attention" and "dismounted." The drivers, when dismounted, will always stand at their horses' heads.

The men for duty with the section will be formed on the parade in two ranks, the roll called, and the detachments told off, the latter taking position in the following order: The surveyor and pin-men on the right, the bar-men with an interval of two paces, the wire-men with an interval of two paces, the lance-men with an interval of two paces, the operators and battery-men with the same interval.

They will be marched in column of detachments to the ground where the train is parked and wheeled into line by the flank previously designated, facing the train.

The section-train being in park, with the detachments in line near it, the chief of train wishing to form the train in column of route, will command—

1. "Form train front, (right, left, or rear.)"
2. "March, (or double time, march.)"

The train is always formed on the line of direction of the battery-wagon, whether the train be in disorder or in park.

At the first command the director, markers, and drivers mount, and director and markers

* The figures refer to the illustrations of the train-drill given in the manual of signals.

and battery-wagon move, if necessary, to take the direction indicated. The chiefs of detachments give the cautionary commands to cause their detachments to move toward the proposed front. At the second command the battery-wagon halts, the director and markers take post twenty (20) paces to the front of the battery-wagon. At the same command, which will be repeated by the detachment commanders, the detachments will move off and form in close column in the same relative order as before, behind the director and markers, (Fig. 28.)

The section being formed for the march, the park will be broken, and it will be moved forward by the command—

1. "Forward,"
2. "March,"

when the director and markers will move forward, followed in order by the column of detachments, the battery-wagon, the wire-wagon, and the lance-truck.

On the march the section is formed as shown in Fig. 29.

The direction and swiftness of the march will be regulated by the movements of the director and markers, under the orders of the captain.

The section being on the march, to halt it previous to opening station, the chief of section commands—

1. "Section,"
2. "Halt."

To open station the chief of section will command—

1. "Open station, right, (or left.)"
2. "March."

At the second command the battery-wagon will move out of the column to the point indicated, and be followed by the battery-man and three (3) operators; at the same time the wire-wagon and lance-truck will close up to the column of his detachment; the driver of the battery-wagon will unhitch his horses and stand at their heads, and the battery-man will make the necessary ground-connection. To open station, the train being in march, the command will be the same, (1. "Open station, right, (or left.)" (2. "March.") At the command "march," the detachments *halt* under command of the chiefs of detachments; the battery-wagon wheels out of the column in the direction indicated, and the wire-wagon and lance-truck close up upon the column of detachments and halt. The command will then be—

1. "Equip."
2. "March, (or double time, march.)"

At the first command, the chiefs of detachments will cause them to face about. At the second command, which will be repeated by the chiefs of detachments, the latter will separate, and move in equal divisions on either side of the train, the operators and two wire-men taking position at and to the rear of the wire-wagon, and the lance-men, bar-men, and pin-men on either side of the lance-truck, where they will take equipments, and face toward the front of the train; the lance-men opposite the rear wheels, the bar-men between the wheels, and the pin-men and the two lance-men who are to deliver lances, opposite the front wheels of the lance-truck. (Fig. 30.) The command will then be given—

1. "To your posts."
2. "March, (or double time, march.)"

At the first command the director and markers move forward 20 paces, and the bar-men raise the bar to the right shoulder, the two designated lance-men mount the lance-truck.

At the command "march," the surveyor and pin-men move to the front, and immediately behind the director and markers. The bar-men follow the surveyor and pin-men. At the same time the lance-truck will pass the wire-wagon, and close up upon the bar-men. The lance-men are marched to the rear of the wire-wagon.

At the command—

1. "Prepare to reel out,"

the director having been instructed by the lieutenant as to the direction and route of the line, moves forward rapidly with the markers, stationing the first marker at a point about 300 feet from the wire-wagon. One of the wire-men takes the end of the wire from the wire-wagon, and makes it fast to the wheel of the battery-wagon. (Fig. 31.) The first pin-man, under direction of the surveyor, marks the first hole about 30 paces from the battery-wagon, a bar-man falls out to make it, and the first lance is delivered by it. The command is then given—

1. "Reel out."
2. "March."

At this command the director moves forward, taking the second marker, and stationing him at a second point on the route, visible to the first marker. The distances between the markers thus placed will be necessarily regulated by the topography of the country. The lieutenant moves forward; the surveyor follows on the line indicated by the markers, and is accompanied by two pin-men.

The first pin-man, with forty marking-pins (for one mile of line) follows the surveyor, who paces the distance of 55 steps, or 132 feet, the distance between poles, and indicates the points where the pin-man shall place the pins.

The second pin-man, similarly equipped, also accompanies the surveyor, and relieves the first when the pins of the latter are used up.

The third pin-man takes station at the first pin placed.

The bar-men (each with a crow-bar) follow the pin-man, making, by the side of each pin thus placed, a hole large enough to admit the foot of the lance easily, and two feet deep, the length of the bar from point to shoulder being the measure, and the hole being made, leaving the pin beside it to guide the lance-men.

The lance-truck will follow close upon the bar-men, the two lance-men in the truck attaching a spike and insulator to each lance, and delivering a lance so prepared at each hole.

The wire-wagon with operators and two wire-men follows the lance-truck reeling out the wire; the first wire-man in the wagon in charge of reel, and the second wire-man following, carrying wire to the line of poles.

The lance-men, eleven (11) in number, follow the wire-wagon, placing the wire in the insulators and erecting the lances, taking care to force them to the bottoms of the holes, and that the insulator-spikes are at right angles to the line, and the insulator properly adjusted.

The third pin-man now follows the lance-men, and as the line is erected gathers the pins and delivers them to the pin-man, who sets them, and who waits at the point where he placed the last pin, when the latter pin-man moves in double time to the front, and relieves at the proper moment the one who precedes him.

The end of the line having been reached, the command will be given—

1. "Take station, right, (or left)."
2. "March."

At the command "march," the lance-truck halts and is passed by the wire-wagon, which moves to take the position indicated by the chief of section, when ground-connection is made by a wire-man. As they come in, the lance-men take position behind the lance-truck, and the bar-men and pin-men behind the wire-wagon. The drivers will then hitch their horses and stand at their heads. The train is now arranged as in Fig. 32.

Having thus formed, the equipments of bar-men and pin-men are returned under direction of the chief of section, and such disposition made of the men as may be advisable, under his directions.

Details should then be made for patrols to guard the line and make repairs when necessary. Each man is made responsible for a certain portion of the line which is assigned to him.

To recover the line, the command is given—

1. "Close station."
2. "March."

The wire-man removes the ground-connection, the horses are hitched to the wagons, and the drivers mount.

At the command—

1. "Prepare to reel up,"

the wire-wagon and lance-truck wheel about on their own ground, and then stand fast. The lance-men, bar-men, and pin-men are faced about. (Fig. 33.)

At the command—

1. "Reel up,"
2. "March,"

the lance-men, commencing at the wire-wagon, draw the lances, free the wire from the insulators, and pass the lances into the truck. The two men in the truck receive lances, detach insulators, and return parts thereof and lances to their places.

The wire-wagon following, reels up the wire, the pin-men assisting the wire-men, and the bar-men taking care that the wire does not run into kinks or become entangled, so as to prevent it from being readily reeled up. Care should be taken that the lance-truck and wire-wagon are not more than 150 paces apart, and the lance-men not more than three lances in advance of the lance-truck.

Upon reaching the central station, and when the lance-truck reaches the first lance, the lieutenant will command—

1. "Section."
2. "Halt."

At the command from the chief of train—

1. "Close station,"
2. "March,"

the wire-wagon reels up to the end of the line, passing the lance-truck, and moves in rear of the battery-wagon. The detachments retain their relative positions, and the horses are hitched to the battery-wagon; the wire-man detaches the line from the battery-wagon, and the battery-man removes the ground-connection. (Fig. 34.)

The chief of train then commands—

1. "Form train front, (right, left, or rear,)"
2. "March, (or double time, march,)"

when the detachments will be promptly placed as directed in the train formed for the march.

The command "form train front, (right, left, or rear,) march," may be given at any time

by the chief of train when it is necessary to change his design of reeling out, &c., provided the wagons are near together.

The general rule governing the movement is, that the director and markers shall move, if necessary, 20 paces in front of the battery-wagon (which is turned toward the proposed front of the train) when the command "form train" is given: then, at the command "march," the detachments will take the shortest line to their places in column, in front of the battery-wagon, and the wire-wagon and lance-truck wheel as nearly into their proper places as the nature of the ground will allow, so that they may gain them at once, then the train is moved forward by the usual commands.

The train being in column *en route*, in order to move in a line to right or left, the chief of train will command—

1. "In line, right, (or left)."
2. "March."
3. "Guide left, (or right)."

At the first command the chiefs of detachments caution them to wheel to the right (or left.)

At the second command each detachment and wagon turns to the right (or left) and moves forward in a line, the guide being towards the director and markers.

The drivers must be careful to preserve their intervals, and keep the heads of their lead horses dressed on the line. (Fig. 35.)

The train may be halted by the command—

1. "Train."
2. "Halt."

The train being in line, (either at a march or halt,) it may be formed in order of column to the right or left and moved forward by the commands—

1. "In train, left (or right)."
2. "March."

At the second command each detachment and wagon will be turned in the direction indicated and move forward in column without further command.

The train being in column, in order to change the march directly to the rear, the command will be given—

1. "Countermarch right (or left)."
2. "March."

At the second command the detachments and wagons halt, with the exception of the director and markers, who wheel about to the right (or left) and move toward the rear of the train, followed in succession by the detachments and wagons, which wheel about in turn into their places in the moving column.

When the train is in line or in column, and it is desired to gain distance to the rear without preserving the prescribed formation, the command will be—

1. "Train right (or left) about."
2. "March."

At the second command each detachment will wheel about to the right (or left:) the wagons at a trot will move to the left (or right) and then wheel to the right (or left) about and take walk when they have their proper distance. If this command be given when the train is in line, the guide will be changed when the new direction is taken.

The train being in march, and it is desired to park it in the line of the direction of march, the chief of train will command—

1. "Forward into park."
2. "March."

At the first command the chief of section will command "right oblique."

At the second command, repeated by the chief of section, the director and markers and the detachments oblique ten paces to the right, when he will command—

1. "Left front into line."
2. "March."

At the second command the director and markers halt, and the detachments execute the prescribed movement; the battery-wagon obliques to the right, and moves at the command "march" to take the post ten (10) paces in the rear of the right of the detachment of bar-men; the wire-wagon moves to take post on line with and ten (10) paces to the left of the battery-wagon. The lance-truck moves into position ten (10) paces to the rear, and in the center of the two wagons, and halts.

To go into park on the left of the line of march the command will be given—

1. "Left into park."
2. "March."

At the second command the director and markers and the detachments wheel to the left and, dressing to the right, march thirty paces to the front, when they will be halted by the chief of section and aligned on the director; the wagons continue the march until the battery-wagon is opposite the detachment of bar-men, when it wheels to the left and takes post ten (10) paces in rear of the right of that detachment. The wire-wagon and lance-truck follow, and take their prescribed posts as in the usual formation. (Fig. 36.)

To go into park on the right of the line of march the commands are—

1. "Right into park."

2. "March;"

and they are executed by reverse movements to those prescribed for "left into park;" but in this case the wire-wagon will pass the battery-wagon before turning to the right.

The drill being dismissed, the detachments will be marched by their respective chiefs to the parade, where they will be dismissed.

Fig. 40 shows the position of a full train in park.

GENERAL DIRECTIONS FOR RUNNING AND ERECTING A FIELD-TELEGRAPH LINES.

They should be as nearly straight as the circumstances will allow. When it is impracticable for any reason to follow a straight line, the divergence should be made with a tree, house, or other firm support at the angle, and this especially if the divergence is large, approaching a right angle. Should such support be unavailable, two or three lances should be set close together to divide the strain.

When following a road or highway the line should be placed beyond the ditch, so as to be entirely out of the way of trains. When crossing country the same object should be kept in view, and the line run along the edge of timber, or the brink of ravines, avoiding ground likely to be selected for the parking of trains, or upon or across which artillery is likely to be moved.

In crossing broken country the surveyor should be careful to place lances upon the brink of declivities and on the top of knolls, in order that no ground between lances shall be high enough to endanger the line, should troops or trains pass under it.

Cross roads as seldom as possible, and when necessary to do so, select, if possible, a point where the road is lower than the banks on either side.

Select ground in which the lance-holes can be easily and quickly made, but avoid sand. Lances should be fifty-three (53) steps apart, but this distance may be varied five (5) to ten (10) steps to avoid bad ground, hard clay, rock, or dry sand.

The sergeant in charge must see that the lance-holes are made of proper depth, and large enough to admit the foot of the lance easily.

The lance-men must force the lances down to the bottom of the hole, and stamp the earth about the lance to make it stand firmly; the insulator-spike must stand at right angles with the course of the line, and the insulators be all on one side of the line of poles.

The wire-men will deliver the wire from the reel only as fast as the wagon moves, allowing no slack, in order that when lifted on the lances it shall be tight and not hang in loose curves.

Clamp-hook insulators should be put on every fourth pole, and on the poles next to a telegraphic instrument.

Form for inspection and review for section train.

FORM FOR REVIEW.

The train will be conducted to the ground appointed for the review by the chief of train, and formed "in line right, (or left,)" facing the stand of the reviewing officer, with the director and markers on the right.

The chief of train takes his place twenty (20) paces to the front and center of the train, facing from it; the chief of section six (6) paces to the front and center of the line of detachments. (Fig. 37.)

At the approach of the reviewing officer, he is received by the chief of train by an individual salute, and the latter advances, faces the train, and commands—

1. "Prepare for review."

2. "Detachments to the rear, open order."

3. "March."

At the command "march," the director and markers and drivers dismount and stand at the heads of their horses. The chief of train and chief of section will remain mounted if the inspector is mounted.

The chief of section, after dressing the front and rear ranks of the detachments, returns to his place in line, when the chief of train commands—

1. "Front."

He will then accompany the reviewing officer along the front of the train from right to left, along the rear back again to the right and front, and take his post.

As soon as the reviewing officer takes his stand, the chief of train faces about and commands—

1. "Close order."

2. "March."

At the second command the ranks are closed, and the director and markers mount. The commands will then be given—

1. "To pass in review."

2. "In train, right."
3. "March."

The chief of train then takes his place three (3) paces in front of the director and markers, and conducts the column in review past the reviewing officer, the right guides or chiefs of detachments passing within six (6) paces of the latter. The chief of train leaves the head of column after saluting the reviewing officer, and remains at his side until the train passes, when he will again take charge, and, if required, pass the train again, in double time. When the train passes in double time no salutes will be given.

Having finally arrived upon the ground where the line was first established, it will again form by the command—

1. "In line, left."
2. "March."
3. "Halt."
4. "Right dress."
5. "Front."

The chief of train then takes his post and reports, saluting as before.

The change of direction in passing in review will be indicated by fixed guidons, or use of the mounted markers.

If the ceremony terminates with a review, the train is at once parked and dismissed.

FORM FOR INSPECTION.

If an inspection is to follow the review, the chief of train will command—

1. "Prepare for inspection."
2. "In train, right."
3. "March."
4. "Halt."
5. "Detachments, rear, open order."
6. "March."
7. "Front."

At the third command, the detachments and wagons will be wheeled to the right and move forward in column.

The fourth command will be given as soon as the wagons gain their places in column, covering as little ground as possible, when the lieutenant will take post three (3) paces in front of his section.

The chief of section takes his place six (6) paces from the head of the column. The director, and markers, and drivers dismount. At the sixth command, when the detachments are (Fig. 38) brought to "rear, open order," the chiefs of detachments remain at the right of the front rank of their detachments.

The inspector, commencing at the head of column, regularly inspects the detachments and wagons in succession, and as soon as he has finished the ranks will be closed by the chief of train, and unless a drill is ordered the train will be at once dismissed.

CHAPTER X.

The lines being erected, the offices must be arranged for the transaction of business, and in case of field or flying telegraphs this is a plain matter, the description of the wagons of the train and direction for use already given having covered the ground. At the central station or battery-wagon the ground-bar is connected to the zinc or negative pole of the battery; the copper or positive pole is connected to one of the screw-posts of the instrument and the line wire to the opposite screw-post. At the outer station the connections are the same, except that the zinc pole of the battery is connected to line-wire (through the instrument) and the copper pole to the ground. At an intermediate station, if any exists, there is no ground-connection, the line-wire being cut and the instrument inserted so that it forms part of the circuit.

Upon permanent lines, where the ordinary Morse instruments are used, the combination of the main and local circuits makes the arrangement of the offices somewhat more difficult, and a few plain directions may be needed. In a terminal office the battery having been placed in position and the ground-connection made, a wire, equal in conducting capacity to the ground-wire, runs to the switch-board in the instrument or operating-room. From the switch-board as many wires as there may be lines to be worked, run to the several instrument-tables connecting through the relay and key of each, and return through the switch-board to the line-wires. Under each table, or in some convenient place, is erected a local battery, the wires from which connect through the magnets of the sounder and the "points" of the relay. At intermediate offices the battery and ground-connection are left out, the line-wires connect through relay and key, and the local wires are run as in the terminal offices. At intermediate offices, on both field and permanent lines, ground-connections

should be prepared and in readiness for use in testing the lines or to enable the office to work to or with that terminal office to which the connection by line-wire is perfect in case of a break in the line. This will be shown in the directions for testing. Ordinarily, on military lines the switch-boards will be unused; the line-wire run directly to the instrument on one side and the wire from the battery to the opposite, the switch-board being a convenience merely and not a necessity. The fundamental conditions are that the line-wires be so connected that the current generated by the main battery, and flowing through them, shall pass through the magnet of the relay and the insulated post and circuit-closer of the key, and that the local wires be so connected that the current of the local battery must pass through the magnet of the sounder and the "points" of the relay. If these are fulfilled the office is ready for business.

The alphabet used is the "General-Service Code" of the Army and Navy, and the signal-numerals thereof are transmitted by blows of the key, like the dots of the Morse alphabet, one blow indicating the numeral 1, and a double blow (two blows made without interval) the numeral 2. It is received by sound, the stroke of the armature of the magnet making the sound.

Written with pen or pencil, the code is this:

Alphabet.	Flag-code.	Telegraph.
A	22	.. ..
B	2112	.. . .
C	121	. . . .
D	222	.. . .
E	12	. . . .
F	2221	.. . .
G	2211	.. . .
H	122	. . . .
I	1	. . . .
J	1122	. . . .
K	2121	.. . .
L	221	. . . .
M	1221	. . . .
N	11	. . . .
O	21	. . . .
P	1212	. . . .
Q	1211	. . . .
R	211	. . . .
S	212	. . . .
T	2	. . . .
U	112	. . . .
V	1222	. . . .
W	1121	. . . .
X	2122	.. . .
Y	111	. . . .
Z	2222	.. . .
ing	2212	.. . .
tion	1112	. . . .
&	1111	. . . .
1	21112	.. . .
2	12221	. . . .
3	22122	.. . .
4	22212	.. . .
5	22221	.. . .
6	12222	. . . .
7	11222	. . . .
8	11112	. . . .
9	11211	. . . .
0	22222	.. . .

Three blows or strokes, without interval, is full stop, and is the only punctuation-mark used.

The points or dots in the above code represent, as has been said, sounds, the single dots single blows of the key in sending or of the armature in receiving signals, and the double ones double blows. It must be borne in mind that the instrument makes two sounds for each stroke of the key, one by the forward motion of the armature, corresponding to the

stroke of the key, and a second by the backward motion of the armature, which occurs when the key is raised or opened. Thus the signal-numeral 1, which is represented in the printed code by one dot, is heard by the operator as the sound of two blows, (differing in tone,) the numeral 2 by four such sounds, (two of each tone,) and the 3 by six. It will be seen that the blows of the forward motion only are significant, those of the backward motion being the result of a "return to position" by the armature. The spaces between them represent intervals of time equal to those occupied in giving the blows. In combining the alphabetic signals to form words this interval must be increased. The rule of practice is this: Whatever the rate of signaling, the time occupied in giving the stroke is the unit of time. Between the signal-numerals of any combination allow one unit of time to intervene. Between letter-combinations (including, of course, abbreviations and numerals) allow two units; between words, four units.

Messages can be sent in this code at from fifteen to eighteen words per minute, but ten words per minute is a good rate of speed, and as much as is safe, if the message is enciphered.

The blows of the key must be firmly and evenly made, especial care being taken to avoid nervousness and haste, which produce uncertain sounds and confuse the receiver. Five words per minute, which the receiver can read without "breaking" or calling for repetitions, is a better rate and will accomplish more in an hour than double or treble that rate interrupted by breaks and frequent repetitions, not to mention the liability to error, which increases rapidly as the rate of transmission is accelerated.

Each office or station will be known by a signal peculiar to itself, which is its "call," and each operator by a personal signal, (usually the initial of the name of the person.)

When a message is received at one station for transmission to another, the operator on duty will "call" the station wanted, by repeating its signal four times, and then that of his own station, and continuing until the signal is perceived and answered. The answer is given by the operator on duty at the called station by opening the circuit, upon which the caller closes, and the called station signals G. A. and the signal of the station. The operator who called then forwards the message, and concludes by sending his own personal signal. The operator receiving the message acknowledges the receipt thereof by signaling O. K. and his personal signal.

When not in use, that is, when no one is signaling, all the circuit-closers are closed—placed in contact—so that the battery-current finds an uninterrupted path, and flows constantly, keeping all the magnets active. This is necessary in order that the line may be ready for use by any station, whether terminal or intermediate, upon it; and to understand how this necessity arises, it is necessary to comprehend the relation of the parts of the line to each other and the manner in which the sounds are produced.

The batteries furnish the current, which is the power by which the signals are made, the conducting-wires carry this current to the points which it is desired to connect, and the instruments are the devices by which the current is manipulated so as to form signals, and by which these signals are made intelligible to the eye or ear of the receiver.

The key has already been described and its offices indicated, as also the receiving-instrument; but the essential portion of any such instrument, relay, sounder, or field-instrument—the electro-magnet—must be thoroughly understood by the student.

An electro-magnet is composed of a soft iron core, usually, though not necessarily, approaching a horseshoe form, around which is coiled an insulated conductor. When an electric current is transmitted through the conductor the iron core becomes magnetic, and continues magnetic as long as the current continues to flow, losing that property again, quickly, upon the cessation of the current.

The batteries and ground-connections being at either end of the line, all the instruments intervening, it will be seen that when all keys are closed (i. e., circuit-closers in contact) the current is constantly flowing, and the iron cores of all instruments magnetic. It follows that by the opening of any one key (circuit-closer not in contact) the circuit or path of the current is interrupted or broken, the current ceases to flow, and the cores are demagnetized. As it is by the alternate magnetization and demagnetization of these cores, made recognizable by the motion of the armatures, that signals are transmitted, the necessity for placing the circuit-closers in contact (in telegraphic phrase "closing the key") becomes apparent. It may be further seen, that while all the offices on any line may receive at the same time what any one may be transmitting, only one operator can be transmitting, and, therefore, the necessity for a careful adjustment of the instrument by the operator, constant attention thereto at all times, and especially before attempting to transmit signals.

By "adjustment" is meant such a regulation of the distance between the poles of the electro-magnet (i. e., the ends of the iron core) and its armature, and of the tension of the armature-spring, as that the armature shall obey the attraction of the magnet when that force is excited by the flow of the current, and move to the front contact promptly, while the tension of the spring shall be sufficient to overcome the residual magnetism of the iron, and any attraction which may result from the flow of current consequent on defective insulation, and withdraw the armature to the back contact upon the opening of any key.

By the phrase "residual magnetism" allusion is made to the fact that the attractive power of the iron is developed gradually, and gradually lost, so that in ordinary signaling the force

of attraction generated by one signal-impulse is not entirely discharged or dissipated before the succeeding impulse is commenced, the result being that the iron is at all times magnetic; strongly so when the current is flowing, and weakly in the intervals. This weak attraction is called "residual magnetism," and must be counterbalanced by the elasticity of the spring. In addition to the residual magnetism, the spring must overcome any attraction of the magnet, resulting from escape. On all lines of any considerable length, a portion of the current passes to the earth through or over the supports, or at points of accidental contact with trees, buildings, &c. This flow develops the magnetism of the iron in proportion to its amount; and this attraction must also (as has been said) be balanced by the tension of the spring.

As these forces are both variable the closest attention is required, and frequent tests must be made by the operator to be certain that the instrument is properly adjusted. On a line which is well insulated, having little loss by escape, the adjustment will be comparatively easy, the difference to be guarded against being that in the rate of speed by different signalists. If a large interval is allowed between the signals, giving time for the discharge of the magnetism of the cores, the signals will be clear with a low tension of the spring; if, on the contrary, the signals follow each other rapidly, a higher tension will be necessary to overcome the residual magnetism. A safe rule is to adjust high enough to get the quickest signals distinctly. Upon a badly-insulated line the matter is more difficult. In this case the adjustment necessary to get the signals from the distant station may be so high as to prevent, or render difficult, the reception of the signals made by a nearer station. Suppose a line with two terminal and three intermediate stations, equidistant, which loses by defective insulation three-fourths of the current generated by its batteries, the loss being distributed equally over its whole length. The opening of the key at one terminal leaves the instrument at the other still acted upon by three-fourths of its battery-current, which flows out at the points of escape, and to recognize the signals the adjustment must be high enough to balance three-fourths of the power of the magnet as excited by the battery-current. At the station next nearer, the opening of the key would cut off the one-fourth of the current which goes to ground at the terminus, and in addition thereto one-fourth of the escape, as one-fourth of the line lies beyond it. At the middle station the open key would cut off one-half the escape, and at the third, or nearest intermediate station, three-fourths of the escape, in addition to the one-fourth that would go through; and thus is rendered necessary a different adjustment to enable the operator at the one terminal to work with the other and with each of the intermediate stations. Practice only can give the operator skill in this respect, and too much attention can scarcely be given it, as from want of skill in adjusting arises much of the delay in transmission of messages, interference with each other by operators, misunderstanding of signals, &c.

CHAPTER XI.

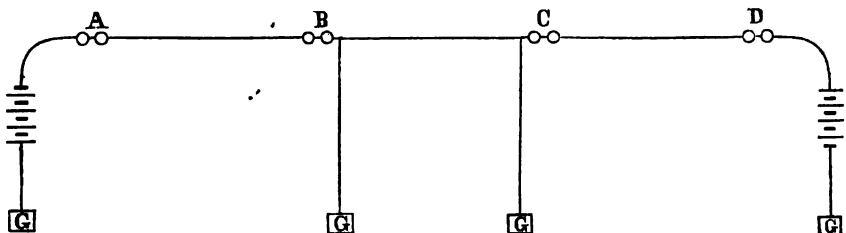
Telegraph-lines are subject to three contingencies which may impede or prevent the transmission of signals. These are the breaking of the conductor, by which the transmission of the signals will be prevented; the loss of current by contact with the ground, (or with other conducting bodies which connect with the ground,) which will render the transmission of signals difficult in proportion as the loss of current is greater or less; and contact between two wires, by which the signals passing upon either may interfere with and confuse those of the other. The first are known as breaks, the second as grounds, (total or partial,) and the third as crosses.

The operation necessary to determine what the fault is, when one is found to exist, and where it is, in order to direct concerning its removal, or to devise means of avoiding or overcoming the difficulty of signaling, is called testing.

This may be, and on long lines without intermediate stations, whether aerial, subterranean, or submarine, necessarily is, performed by the aid of a galvanometer and artificial resistance. These methods are many, and are capable of locating and defining a fault with great certainty and exactness, by comparing the known resistance with the unknown, but as the delicate instruments and apparatus are unfit for military service, and the conditions precedent necessary to testing in this manner generally wanting on military lines, the student is referred to more elaborate works for knowledge thereof, and the common methods of testing with the ordinary instruments only will be considered. If a line be broken, and the broken ends of the wire prevented from falling to the ground, or having fallen rest on dry earth or sand, the apparent result will be a stoppage of the battery-current, made appreciable by the non-action of the magnets at the adjustment in use previous to the breaking of the wire. Attempts to adjust the magnets to the new condition will show no current if the accidental connection to earth be very slight, and in any case only such as is due to escape, over-defective insulation, and the imperfect contact at the break. The work of locating such faults lies with the intermediate offices. When the power of the magnet is much reduced or lost at any station intermediate between the termini of a line, the operator should, by placing his

ground-wire in connection with the line on one side or the other of his instrument, ascertain in which direction the fault lies. If with the ground-wire on one side he finds the power of the magnet restored, the fault is beyond the ground-wire. If with the ground-wire on the opposite side he receives a feeble current, indicated by a weak action of the magnet, the line is on the earth, but not broken. If no current is received the line-wire is broken. If, after testing on each side, no effect is found, (the magnet remaining inactive,) the probability is that the fault is in the testing-office, and it should be at once cut out, and carefully inspected and tested. Fig. 39 is a diagram of a line with four stations, broken between the intermediate or "way" stations. It will be seen that there are formed by the use of the ground-wires at the way stations two separate circuits, one from A to B, the power furnished by the battery at A, and one from C to D, the battery at D furnishing the power.

Fig. 39.



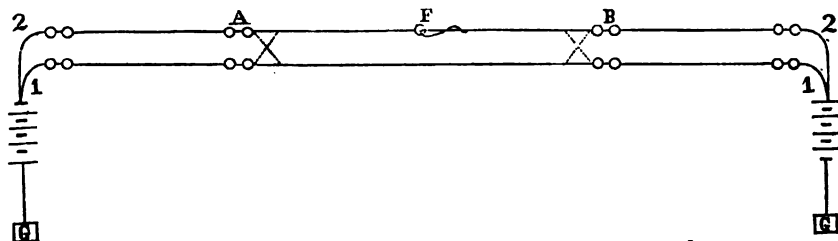
Were the line not broken, but merely thrown upon moist earth at the same point, the result would be the same, practically, without the use of the ground-wire, the earth-contact acting as ground.

Breaks are usually the result of violence to the line-wire, but occur not infrequently in offices by the carelessness of an operator in not closing his circuit after working, or by the loosening of a binding-screw about the instrument or switch. The fine wire of which the coils of the magnets are made is sometimes burned off by atmospheric electricity, with the same result.

When a break has been improperly repaired, as by making a "hook-joint," (so called,) by which the conducting capacity of the line is but partially restored, the result is the same as though additional wire had been attached; the battery-current, encountering more resistance, excites the magnet less powerfully, and the transmission of signals is less prompt and certain. This fault may be found in the same manner, or if there be more than one wire the device of cross-connecting them may be made use of.

Fig. 40 represents a line having two conductors and intermediate stations. A partial disconnection exists at F in No. 2 wire, which, by cross-connection at A and B, is shifted

Fig. 40.



into No. 1 wire at the terminals, showing that it is between the cross-connections. It will be seen that any fault except a cross (which affects both wires alike) can be tested for in the same manner.

Grounds are tested for by a terminal station by calling the most distant station and noting the strength of the current, (by its effect on the magnet,) when the circuit is left open, and the tension of adjustment-spring necessary to get signals clearly from the distant office, and by comparison with the results of the same experiments with the other stations in succession. When the open key shows only the ordinary amount of escape, and the signals come clearly at the ordinary adjustment, the fault is passed. If the change is sudden, the current is escaping principally at one point between the last station which required a "high" adjustment and the first which worked on a lower. If the change is gradual, as station after station is tested with, the fault is a general defect in insulation, broken or faulty insulators, or contact with trees, shrubs, &c.

Crosses may occur between the wires of an intersecting line, in which case they can be tested for by the same methods as those employed to locate grounds; or between parallel

wires of the same line. When the latter is the case the terminal station conducting the test should direct the other terminal station to open circuit on one of the wires, and each of the intermediate stations, one after the other, commencing with the most distant, to make signals on the wire which remains closed. As long as the cross is between the operator making the signals and the testing-terminus the signals will come on both wires, but as soon as the cross is more distant than the signaling operator, they will come on the one in which they are made only, the other remaining closed.

If one of the wires only is in the way stations, the testing terminals can make a loop-test by directing the other terminus to open circuit on both wires, and connecting one of them to earth outside the battery. Signals made at the testing-station will then go out on one wire to the cross and back on the other to earth, and the cross will be found beyond the farthest station that hears the signals. All stations beyond the cross will have open circuit, or no current.

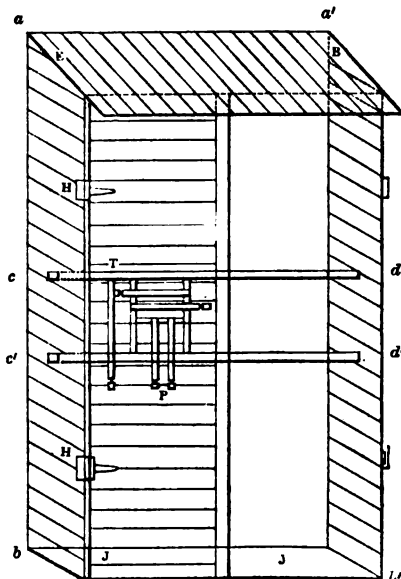
While a cross exists one wire should be kept open in order that the other may work uninterruptedly; or, having located it, let the stations on either side disconnect the line-wire from their instruments on the side next the "cross," and substitute a ground-wire. The terminus can then use one wire "through," and each can reach the way stations between itself and the fault by the ends of the divided wire.

PAPER B.

INSTRUCTIONS TO OBSERVER-SERGEANTS, SIGNAL-SERVICE, ON DUTY AT STATIONS OF OBSERVATION, UNITED STATES ARMY, AND REPORT PREPARED UNDER THE DIRECTION OF THE CHIEF SIGNAL-OFFICER OF THE ARMY.

INSTRUCTIONS.

1. Each observer, upon arriving at his station, will immediately proceed to secure a room suitable for office purposes and the storage of instruments and other United States property in his charge. This room must be in the immediate vicinity of the telegraph office charged with the transmission and receipt of the weather reports, and should be in the upper story of a building, and contain at least *one* window facing the north. In all cases he will endeavor to get permission to occupy the roof of this building for the necessary exposure of his instruments, and, at stations specially designated by the Chief Signal-Officer, for the erection of an instrument-room, in accordance with plans furnished by this Office. When such permission cannot be obtained, or a suitable roof found, and at all stations not designated as above, an instrument shelter will be constructed similar to the one described in the Smithsonian directions for taking meteorological observations, as follows:



Select a window fronting the north; remove the lattice-blinds, if there be any, and along the exterior jambs of the window place perpendicularly two pieces of lattice-work (*a b*, *a' b'*) projecting to a distance of from twenty to twenty-four inches from the panes. At half this distance, ten or twelve inches from the panes, and at the height of the eye of the observer, when in the chamber, pass from one end of the shelter to the other two small wooden transverse bars (*c d*, *c' d'*), each an inch broad, for the purpose of supporting the instruments. Upon the outer edge of the sides fasten, in the usual way, (*H H*), the latticed blinds which were removed from the jambs, or two others provided for the purpose. That blind behind which the instruments are to be placed is to serve as a screen, and must be fastened, almost entirely closed, so as to make a little more opening; the other may remain open, to allow a free access of air and light, and need not be closed except in great storms. The whole must be covered with a small inclined roof or boards. (*B E*), placed at least fifteen or twenty inches above the instrument. The lower part, (*J J*), or the basis, may remain open, unless the shelter is within ten feet of the ground, in which case the bottom will be covered with slats two inches wide, placed one inch apart.

The building selected should be detached from other buildings, and, where this cannot be had, should be higher than those surrounding it.

Too much attention cannot be given to the proper setting up of the instruments and their protection from local influences.

2. An observer, upon arriving at his station, will, as soon as practicable, put himself in communication with the board of trade, chamber of commerce, board of underwriters, and such other bodies as may desire to co-operate with this Office in its efforts to make the service locally, as well as generally, useful. If meteorological committees have not been appointed by any or all of these bodies, their appointment should be urged as a matter of special importance, and the committees requested to place themselves in communication with the Chief Signal Officer. He will also communicate with such colleges, scientific associations, and other institutions of learning as may be located at or near his station, and will explain to their officers and members the nature and object of his duties, and invite their co-operation. He must bear constantly in mind that it is expected he will use every effort in his power to render his office of the greatest public utility.

3. The office-furniture will be of the plainest kind, and consist only of such articles as are absolutely necessary for the proper transaction of business. The room, furniture, and instruments must be kept neat and clean at all times, and always prepared for inspection.

4. The regular reports from station — will commence with the morning report of —, and from and after that date three observations will be made daily, and transmitted by telegraph, to —, and three observations, at different hours, for transmission by mail weekly to this Office.

5. The observations for telegraphic transmission will be taken daily at — a. m., — p. m., and — p. m., (local time,) and, after the proper corrections are made, will be entered on Form 5, supplied by this Office, and also in the daily record of observations and the record of bulletins, and a weekly record of them on Form 4 will be sent to this Office. The instruments will be read in the following order:

- | | | |
|----------------|-----------------|----------------|
| 1. Barometer. | 2. Thermometer. | 3. Hygrometer. |
| 4. Anemometer. | 5. Anemoscope. | 6. Rain-gauge. |

6. The reports will be handed by the observer in person to the operator charged with their transmission, in the order and at the times named below, viz: Report No. 1, at — a. m.; report No. 2, at — p. m.; report No. 3, at — p. m.

7. Observers must be at the telegraph-office, with the reports carefully and plainly written out *in duplicate*, ten minutes before the hours named above, in order that the operator may be notified in time to prepare for their transmission, and must obtain the signature of the operator to *both copies of each report*, with the exact time of receipt by him. They will also furnish the manager of the office with a plainly written or printed list of stations (with their proper telegraphic numbers) from which reports are to be received at, and also of those to be sent from, his office, with the names of the stations to which they are to be sent. If reports are to be transferred or selected for transfer at any station, the observer at that station must personally attend to such transfer or selection, unless prevented by sickness or other extraordinary cause. To provide against such an event, he must so arrange with the manager that the regular transmission of reports will not be interrupted by his absence.

8. The following is a list of stations, with their proper telegraphic numbers. Those to be received at station No. — are underlined in red ink, and any failure to receive them must be promptly reported to this Office, with a statement of the probable cause of failure:

Station.	No.	Station.	No.
Plaister Cove, Nova Scotia.....	10	Boston, Massachusetts.....	13
Saint John, New Brunswick.....	11	New London, Connecticut.....	14
Portland, Maine.....	12	New York City, New York.....	15

Station.	No.	Station.	No.
Albany, New York.....	16	Punta Rassa, Florida.....	59
Philadelphia, Pennsylvania.....	17	.....	60
Baltimore, Maryland.....	18	Vicksburgh, Mississippi.....	61
Washington, District Columbia.....	19	Memphis, Tennessee.....	62
Wilmington, North Carolina.....	20	Nashville, Tennessee.....	63
Charleston, South Carolina.....	21	Louisville, Kentucky.....	64
Savannah, Georgia.....	22	Cincinnati, Ohio.....	65
Augusta, Georgia.....	23	Saint Louis, Missouri.....	66
Lake City, Florida.....	24	Omaha, Nebraska.....	67
Key West, Florida.....	25	Cheyenne, Wyoming Territory.....	68
Montgomery, Alabama.....	26	Santa Fé, New Mexico.....	69
Mobile, Alabama.....	27	Corinne, Utah.....	70
New Orleans, Louisiana.....	28	Fort Benton, Montana Territory.....	71
San Francisco, California.....	29	Shreveport, Louisiana.....	72
Norfolk, Virginia.....	30	Jacksonville, Florida.....	73
Oswego, New York.....	31	Portland, Oregon.....	74
Rochester, New York.....	32	San Diego, California.....	75
Buffalo, New York.....	33	Denver, Colorado.....	76
Cleveland, Ohio.....	34	Virginia City, Montana Territory.....	77
Toledo, Ohio.....	35	Port Stanley, Canada.....	78
Detroit, Michigan.....	36	Port Dover, Canada.....	79
Chicago, Illinois.....	37	Kingston, Canada.....	80
Milwaukee, Wisconsin.....	38	Saugeen, Canada.....	81
Saint Paul, Minnesota.....	39	Breckenridge, Minnesota.....	82
Du Luth, Minnesota.....	40	Fort Sully, Dakota Territory.....	83
Pittsburgh, Pennsylvania.....	41	Indianola, Texas.....	84
Knoxville, Tennessee.....	42	Alpena, Michigan.....	85
Indianapolis, Indiana.....	43	.....	86
Lynchburgh, Virginia.....	44	La Crosse, Wisconsin.....	87
Burlington, Vermont.....	45	.....	88
Mount Washington, New Hampshire.....	46	.....	89
Keokuk, Iowa.....	47	.....	90
Grand Haven, Michigan.....	48	.....	91
Escanaba, Michigan.....	49	.....	92
Marquette, Michigan.....	50	.....	93
Davenport, Iowa.....	51	.....	94
Leavenworth, Kansas.....	52	.....	95
Cairo, Illinois.....	53	.....	96
Cape May, New Jersey.....	54	.....	97
Galveston, Texas.....	55	.....	98
Montreal, Canada.....	56	.....	99
Quebec, Canada.....	57	.....	100
Toronto, Canada.....	58	.....

9. At each station an observation of the barometer will be taken daily at 12 m., Washington mean time, and if a change equal to, or greater than, fifteen-hundredths of an inch has taken place since the regular morning telegraphic observation, the fact will be reported immediately by telegraph to the Chief Signal-Officer, with the direction of wind and state of weather, and the velocity of the wind in miles per hour; the whole being sent in the same order in which they are given here, and in the regular cipher words. A regular weekly report of these mid-day observations will be made out on Form 4 and mailed to the central office with the other reports on this form.

In these special reports the barometer will be corrected, in the usual manner, for temperature, elevation, and instrumental error.

10. In addition to the observations made for telegraphic transmission, three others will be taken daily—at 7 a. m., 2 p. m., and 9 p. m., (local time,) respectively. These will be recorded upon Form 4 in the same manner as the telegraphic observations, but on a separate sheet, and a copy of them will be forwarded weekly by mail to the office of the Chief Signal-Officer.

11. After delivering his own reports to the operator, each observer will remain in the telegraph office until they are sent to their proper destination, and until the reports from other stations intended for use at his station are received, or until assured that their receipt has been prevented by some cause beyond the control of the operator. The reports for Station No. — should be received by — a. m., — p. m., and — m., respectively; and when

they are delayed beyond these hours, the facts should in all cases be promptly reported to this Office by mail, with a statement of the cause of delay when known.

12. To avoid useless delay in getting out the bulletins, observers should arrange, whenever practicable, to have the use of a desk or table in or near the operating-room of the telegraph-office, in order that the reports could be translated and written out properly as rapidly as received. Where permission to occupy the room for this purpose is granted by the manager, a small table will be furnished by this Office for the use of the observer, whenever necessary.

13. The telegraph-offices at which the reports are received will be kept constantly supplied by the observers with Form 2, and in all cases the receiving operator will be required to fill in the name of station, date, and time that reports are received. Observers will in like manner fill up Form 5 before delivery.

14. Reports must be made on Sundays at the regular hours, and delivered punctually at the telegraph-office.

15. Immediately upon the receipt of the morning reports at any station the observer will translate them into ordinary language, and write them out clearly and plainly on the bulletin sheet, (Form 3,) filling in each column with the data named in its heading. The manifold issue of the bulletin will be used, and when completed, copies will be regularly posted in the rooms of the board of trade, chamber of commerce, and such other conspicuous places as may have been officially designated. Copies may also be furnished to private individuals when personal application is made for them at the observer's office, and their preparation does not interfere with the issue of those designed for public use, or with the ordinary and regular duties of the station. A copy will be furnished to each evening newspaper published at the station and its regular publication secured if possible. The local observations will invariably be entered in all bulletins, press reports, and maps. At stations supplied with the manifold maps, their preparation follows the bulletin, and they will be printed as rapidly as practicable, and furnished to such parties as may be designated by this Office, upon the recommendation of the observer in charge. The "War Department Weather Map" will then be changed in accordance with the following key and instructions.

The index consists of an arrow, disk, and card, which show the direction and velocity of the wind, state of the weather, height of the barometer, and height of the thermometer, and relative humidity at the place on which they are affixed. The index will be changed once daily, at 10 a. m., or as near that hour as is practicable. The arrow flies with the wind.

A red disk indicates clear weather.

A blue disk indicates sky covered with clouds.

A $\frac{1}{2}$ -blue disk indicates sky $\frac{1}{2}$ covered with clouds.

A $\frac{1}{4}$ -blue disk indicates sky $\frac{1}{4}$ covered with clouds.

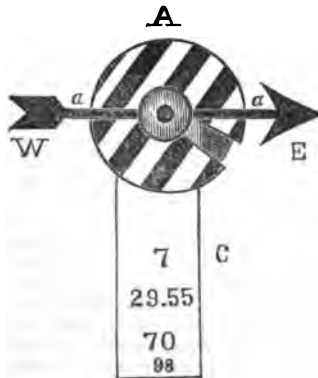
A $\frac{3}{4}$ -blue disk indicates sky $\frac{3}{4}$ covered with clouds.

A black disk indicates rain.

A white and black barred disk indicates snow.

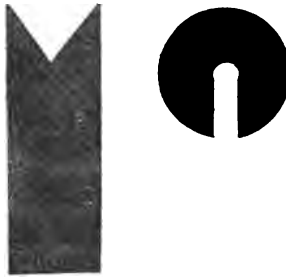
A yellow card projecting below the disk, and held in position by the same screw that fastens the arrow and disk, shows the velocity of the wind in miles per hour, the height of the barometer in inches and hundredths, and the height of the thermometer in degrees Fahrenheit, and the percentage of humidity.

Example:



The barred disk A indicates snow, and the position of the arrow *a a* that the wind is blowing from the west, the upper figure on the card, *c*, shows that the velocity with which the wind is blowing is seven miles per hour. The height of the barometer, shown by the middle figures, is twenty-nine inches and fifty-five hundredths, the height of the thermometer seventy degrees above zero, and the relative humidity, indicated by the lower figures, is

ninety-eight per cent. When the temperature is below zero the minus sign should always be prefixed. To facilitate changing the disks and cards they are cut so as to slip on and off without removing the clamp, as shown in the following figures:



A calm is indicated by the omission of the arrow.

16. The afternoon reports will be received and translated in the same manner as those received in the morning, and will be bulletined at such places as will insure the greatest publicity. At stations where the morning papers go to press too early for the publication of the midnight report, they will be furnished with the afternoon issue.

17. The night reports, after translation, will be carefully and promptly written out on Form 3 and furnished to such morning papers printed at the station as desire them for publication. Observers will endeavor to arrange with the publishers to have the reports taken from the observer's office, but where this arrangement cannot be effected, the observer, or his assistant, will deliver them in person at the different newspaper offices.

18. At stations where the publishers of newspapers desire to have the three reports of the previous day, they will be supplied by the observers on the manifold form issued by this Office for that purpose. In such cases, observers will write up the morning and afternoon reports during the day and evening, so that there will be no delay in getting out the full report at midnight. In filling out the heading of the daily bulletin, for publication, the time of the reports will be the exact local time of the place of publication, and will be so stated at all stations. In carrying out that part of their duty which relates to the publication and distribution of reports, observers will be required to act promptly and intelligently, as the usefulness of the reports depends wholly upon the speed and accuracy with which they are laid before the public.

19. *In furnishing weather reports and items for publication, observers must confine themselves strictly to the instructions issued from this Office, and will not, under any circumstances, publish, or cause to be published, forecasts or predictions of the weather not originated by this Office.*

20. At each station a daily record will be kept of missing reports, showing the name and official numbers of stations, with the cause of their non-receipt when known, and also such other telegraphic errors as may come to the observer's knowledge. A copy of this record on Form 19 will be forwarded weekly to this Office in the same package with the originals of Form 2.

21. A copy of the latest synopsis received by the Associated Press at stations where it is regularly received will be posted with each copy of the bulletin that is publicly displayed. These copies will be made in manifold on Form 15 furnished by this Office.

22. Observers will be held directly responsible for the correct publication of all weather reports at their respective stations, and must take every precaution to guard against errors, especially in the newspaper copies, where they are most frequently found. The accuracy of the published reports must be verified by daily personal inspection, and when errors are found they should be traced to their proper sources and measures taken to prevent their repetition as far as it is in the power of the observer. The use of the regular official heading authorized by this Office for all reports must be insisted upon, and care taken that correct time of issue is given to both the bulletin and synopsis.

23. When the wires of the telegraph company by which the reports are regularly transmitted are known to be down or obstructed in such a manner as to prevent their prompt transmission, they will be sent, until such obstruction is removed, over the wires of any other company possessing the necessary facilities.

24. In all reports and bulletins posted or furnished to the press for publication, due credit must be given to the telegraph company over whose wires they were received.

25. At all stations ordered to make river reports, the depth of water above low-water mark will be observed at 3 o'clock (local time) each afternoon.

The sixth space in first line of Form 5 will be used for the depth in feet whenever the number exceeds eight, and the sixth space in second line for the odd inches.

Whenever the depth does not exceed 8 feet, the word "River" will be used to fill the space in the first line, and the whole depth given in the second line in inches. The heading "Change in last 24 hours" will be erased from the cipher manual.

In furnishing the reports to the press, and in filling up the Bulletin, Form 3, both the

depth of water and the daily change will be given. The change will be obtained by taking the difference between the current report and that of the preceding day.

26. Whenever any sudden or unusual change occurs in the condition of the river between the regular hours of river observations, the observed unusual depth will be reported in the usual manner at the next succeeding telegraphic report, and these special reports will be continued tri-daily (one at each telegraphic report) until the river resumes its normal condition, when the morning and midnight specials will be discontinued.

27. In carrying out these instructions, observers will use the cipher words in the column headed "Rise," when the river is rising at the date of report, and those in the column headed "Fall," when it is falling.

28. The observations for the morning and midnight special river reports will be made within an hour of the time of report if practicable.

Observers must exercise great care in making and recording the river reports, in order that they can be relied upon as accurate by interested parties.

29. The amount of rain-fall (or melted snow) will be measured and reported at each of the three telegraphic reports only.

INSTRUMENTS.

30. Each station will be supplied with the following instruments:

- One standard barometer, (Green's.) (Signal-service U. S. A.)
- One standard thermometer, (Green's.) (Signal-service U. S. A.)
- One standard hygrometer, (Glaisher's model.)
- One maximum thermometer. (Signal-service U. S. A.)
- One minimum thermometer. (Signal-service U. S. A.)
- One anemometer, (Robinson's.)
- One wind-vane. (Signal-service U. S. A.)
- One rain-gauge. (Signal-service U. S. A.)
- One clock.

Other instruments may be added from time to time as the necessity for their use becomes apparent.

BAROMETER.

31. The barometers will in all cases be carefully compared with the standard at this Office before issue, and the amount of instrumental error will be sent with each when it leaves this Office.

The barometer should be placed in a room of a temperature as uniform as possible, not heated nor too much exposed to the sun. It should be suspended at the height of the eye, near a window, in such a manner as to be lighted perfectly without exposure either to the direct rays of the sun or to the currents of air which are always found at the window-casings and doors. To protect the instrument from external injuries, from dust, and from the direct radiation of warm bodies or the currents of air from the window, observers will fasten the wooden case in which it is carried firmly against the wall in a vertical position near the window, in such a manner that the cover will open in a direction parallel to the panes. An opening large enough to admit the tube of the barometer will be cut in the upper end of the box; and directly above this, at the distance of one inch, a strong hook will be driven into the wall. This hook should extend two or three inches beyond the box, and upon it the instrument will be suspended. When not in use the cover will be closed; but when an observation is to be taken it will be opened, and the instrument drawn out on the hook, clear of the box, and in the full light of the window. After the observation is made the barometer will be slipped back into the box.

32. All readings of the barometer taken for telegraphic transmission will be corrected by the observer making the observation, for *instrumental* error, for *temperature*, and for *elevation*, before they are sent from his station. In correcting for temperature, the reading of the *attached* thermometer will be used, while in correcting for elevation the temperature used will be that of the exposed or open-air thermometer.

In correcting for elevation, the height of the surface of the mercury in the cistern of the barometer above the ground must be added, in all cases, to the height of the station above sea level, as in the following example, viz: suppose height of station above sea level to be 670 feet; height of mercury (surface) in cistern to be 17 feet above the ground; then the elevation to be corrected for would be 687 feet.

In correcting for temperature, Table XVII, pages 66 to 71, paper C, of Guyot's tables, will be used; and for elevation, Table XIX, page 92, paper D, of the same book, when special tables prepared at this Office are not furnished.

33. In transporting a barometer, even across a room, it should be screwed up, and carried with its cistern uppermost. For traveling, it is provided with a wooden case. On steam-boats or railroads, it should be hung up by a hook in the state-room or car, and the lower end firmly strapped to the side of the room or car to prevent jarring. In wheeled vehicles, it should be carried by hand, supported by a strap over the shoulder, or held upright between the legs; but it should *not* be allowed to rest on the floor of the carriage, for a sudden jolt.

might break the tube. If carried on horseback, it should be strapped over the shoulders of the rider, where it is not likely to be injured, unless the animal is subject to a sudden change of gait. When about to be used, it should be taken from its case, and, while screwed up, gently inverted and hung up, when it can be unscrewed. While it has its cistern uppermost, the tube is full—is one solid mass of metal and glass—and not easily injured; but when hung up, a sudden jolt might send a bubble of air into the vacuum at the upper end of the tube, and the instrument would be useless until repaired. Observers must never *swing* the barometer or endeavor to force the mercury against the top of the tube without first screwing up the large adjusting screw at the base of the cistern.

If the cistern should become dirty, it can be cleaned with safety, and without changing, in the slightest degree, the zero of the instrument. Everything used in the operation must be clean and dry. Blowing upon any of the parts must be avoided, as the moisture from the breath is injurious.

The instrument being placed upright, the cistern uppermost, unscrew and take off the brass casing which incloses the wooden and leathern part of the cistern. This wooden part (which has the grain crosswise, and therefore is not air-tight) is made in two pieces, fastened together by four screws and four brass pieces, each in the form of a half of a circular ring. It will be necessary to take out two of these screws and loosen the other two, when the brass pieces can be taken off. The upper wooden piece, to which the bag is attached, can then be lifted off, and the mercury will be exposed. By then inclining the instrument a little, a portion of the mercury in the cistern may be poured out in a clean vessel at hand to receive it, when the end of the tube will be uncovered. This is to be closed by the *gloved hand*, when the instrument can be inverted, the cistern emptied, and the tube brought again to its upright position. Great care must be taken not to permit any mercury to pass out of the tube. The long screws which fasten the glass portion of the cistern to the other parts can then be taken off, the various parts wiped with a clean cloth or handkerchief, and restored to their former positions. The mercury which had been taken out of the cistern must now be cleaned, or it must be replaced by other that is clean and pure. If the old mercury is merely dusty, or dimmed by a film of oxide, the cleaning may be effected by straining it through chamois leather, or through a funnel with a capillary hole at the end, of a size to admit of the passage of but a small thread of the metal. Such a funnel is conveniently made of letter-paper. The dust will adhere to the skin or paper, and the filtered mercury will present a clean and bright appearance. At stations where muriatic acid can be procured, the mercury may be easily and quickly cleaned by mixing about two ounces of the acid with it in a small vessel or cup and then pouring into the vessel clear water until it overflows and carries off all the impurities. When sufficiently pure the water will be poured off and the mercury heated over a gas or lamp-light until all remaining moisture is expelled. If chemically impure, it should be rejected, and fresh, clean mercury used. With such clean mercury, the cistern should be filled as nearly full as possible; the wooden portions put together and securely fastened by the screws and clamps; the brass casing screwed on, and the screw at its end screwed up. The instrument can then be hung up and readjusted. The tube and its contents having been undisturbed, the instrument should read the same as before. If a little mercury has been lost during the operation, and there is none at hand to replace it, no serious harm has been done; but if much is lost, the open end of the tube may become exposed in inverting the instrument, in which case air may enter. To guard against this error, a little fresh mercury will be added if it can be procured.

THERMOMETER.

34. The thermometer should be hung in the open air facing the north in such a manner that it will be always in the shade, and at least one foot from the wall or the building to which the shelter is attached, where the Smithsonian form of shelter is used. It must be protected from the light reflected from surrounding objects, and from rain, snow, and hail. The instrument must be placed exactly perpendicular, the middle of the scale being at the height of the eye in order to prevent error in reading. The readings should be made at all times, and, especially in the winter, *through the panes*, without opening the window, when the shelter is built out from a window. When the shelter is built upon a roof, great care must be exercised in making the readings in order to prevent the instrument from being affected by the heat of the body or of the lantern at night. The observations must be made as rapidly as is consistent with accuracy.

HYGROMETER.

35. The hygrometer will be placed in the same shelter as the thermometer, and at a distance of one foot from it. The cistern will be kept supplied with pure water at all times when the temperature of the air is above the freezing point, and the cover of the wet bulb will be changed every month, and the bulb carefully cleaned. The cover may be washed as often as necessary, without removal, by means of a jet of clean water from a small syringe.

When the temperature of the air is below the freezing point, the water will be emptied from

the cistern, and the wet bulb will be moistened with cold water by means of a camel-hair brush fifteen minutes before the observation is made, or long enough to permit the ice to form and dry on the bulb. The coating of ice allowed to form should be very thin, otherwise the reading will be inaccurate. Alcohol must not be used to prevent the water from freezing. The reading must be made rapidly, and without opening the window. The relative humidity of the air will be obtained from Table VII, page 46, paper B, of Guyot's tables.

Especial care must be taken to keep the tubes of the hygrometer clean, and the wet bulb properly moistened, and to make the observations and deductions accurately, as the humidity of the air forms an important element in all calculations of atmospheric changes.

Whenever the dry bulb of the hygrometer is observed to show a higher temperature than the exposed thermometer under similar exposure, the observer will cut a circular opening, about three inches in diameter, in the board to which the dry and wet bulbs are attached, and directly behind the bulbs.

MAXIMUM AND MINIMUM THERMOMETERS.

36. A board will accompany these instruments, which will be securely fastened with screws, in a horizontal position, upon the side of the instrument-shelter, or observatory, near the hygrometer and exposed thermometer.

The brass support for the minimum will be screwed into the upper part of the board; the holes being so arranged as to slightly incline the left end of the support.

The top of the thermometer will be fastened by the small brass screw upon the support, while the lower end will be dropped into the notch to the left.

For the support of the maximum thermometer the long brass pin with a nut will be screwed into the board, in the hole to the extreme right. The nut will be taken off and the pin slipped through the hole in the upper end of the instrument, which will be securely fastened by replacing the nut and screwing it tightly. The plain brass pin is then inserted in the hole at the left of the board, and the thermometer placed upon it so as to incline slightly in that direction.

The end of the pin to which the maximum is attached must be occasionally oiled to prevent friction.

After unpacking the minimum it must be carefully compared with the exposed thermometer, and if an air speck is found in the column, the bulb will be immersed in warm water until all the air-bubbles disappear in the space at the top of the tube, *great care being taken not to break the bulb by heating it too suddenly.*

After fastening the top of the minimum upon the support, the lower end of the instrument will be raised until the top of the small index touches the top of the column of spirit.

The instrument is read by observing the number of degrees upon the scale where the top of the index rests. After taking a reading, the bulb or lower end of the thermometer should be elevated until the index comes down to the temperature of the air, at the time of the observation, and the instrument will then be dropped into the notch at the left of the support, as before.

The maximum is read by observing the number of degrees upon the scale at the top of the column of mercury.

After taking a reading the observer will remove the pin to the left, and then take hold of the thermometer, about three inches from the top, and spin it around several times, or until the top of the column is brought down to the temperature of the air at the time of observation. Care must be taken not to touch the bulb, and also that the nut is screwed up sufficiently tight to prevent the instrument from striking against the side of the board to which it is fastened. After adjustment, gradually raise the instrument to a horizontal position, and insert the pin as before.

Care should be taken in elevating the thermometer not to raise the bulb too high, as the column of mercury would then run to the upper end of the tube.

The observations upon these instruments will be made at the 11.35 p. m. report, and recorded upon Form 4, in the proper column.

ANEMOMETER.

37. The anemometer will be fixed in a vertical position upon a post of sufficient height to bring the dial on a level with the eye of the observer, and will be in an exposed situation, so as to receive the full force of the wind; when possible, this post should be framed into the roof, to steady it and prevent the instrument from vibrating; but when this cannot be done, it should be framed at the bottom into two pieces of scantling, not less than three feet in length, that cross each other at right-angles, and which can be nailed fast to the roof or platform upon which the instrument is placed. Short braces can be added when necessary to insure steadiness. The outer dial of the instrument is graduated in miles and tenths of miles—the figures 1, 2, 3, &c., indicating miles, and the subdivisions tenths. One complete revolution of this dial is equivalent to ten miles of wind, and carries the inner dial forward one subdivision. This inner dial registers up to one thousand miles, and will not be used in making ordinary observations, but will be read by observers daily when making

the morning telegraphic observation. To obtain the velocity of the wind for the regular tri-daily telegraphic observations, two readings of the outer dial must be taken, with an interval of five minutes between them, and the *difference* between these readings will be the distance of tenths of miles traveled by the wind in that interval. This, multiplied by twelve and divided by ten, will give the proximate velocity in miles per hour. Example: suppose the index of the outer dial to be at 3 when the first reading is taken, and at 3.6 five minutes after, the difference, 6, is the distance traveled in that time; and this multiplied by twelve and divided by ten, gives a velocity of seven and two-tenths miles per hour. Whole numbers only will be used in expressing the velocity. When the decimal is greater than five-tenths, the unit's figure will be increased by one; when five or less it will be thrown out. The whole distance traveled by the wind in any twenty-four hours, provided it does not exceed one thousand miles, will be obtained from the inner dial by a double observation as above, making the interval twenty-four hours instead of five minutes, and will be entered on both copies of Form 4, opposite the morning observations.

38. The following directions for setting up and the general management of the electric self-recording anemometer attachment adopted by this Office will be observed at all stations supplied with this apparatus.

Near the top of the post on which the anemometer is fixed place two screws "c" and "d," (Fig. I,) to each of these screws fasten the wires separately, (the insulated wire to one, and the naked wire to the other,) leaving just sufficient of the upper end of each wire to reach to the outside ends of the contact bars "a" and "b," to which securely fasten with the binding screws, taking great care not to loosen the insulating attachment "g." Then pass the lower ends of the wire down the post, over the roof and down the side of the house (securing so the wind will not sway them) to the top of the office window, pass them in through two small holes (where the sash and shutters will not injure them) and down the inside. In crossing the roof it is well to fasten them between two wooden strips, one on top of the other. One wire should then go to the screw-cup "h," (Fig. II,) and the other to one pole of the battery at "i," then from the other pole "m" of the battery run a wire to the screw-cup "k," when the circuit is completed and the armature will be closed once for each mile the wind travels.

Particular care must be taken that all the connections are tight.

For putting on the paper.—Place the cylinder "a" on a table in front, with the screw "r" to the left hand, place the paper on the cylinder with the top of it from the screw. Let the line marked 12 m. (noon) come on the line marked on the cylinder, and place a small rubber band on each end. The lines on each end of the paper will then exactly coincide.

Place the cylinder "a" in its position, so that the end on which there is no screw "r" will be close up to the post on which it rests. Slide the small sliding bar "n" on the horizontal bars "o" "o," until it fits on the ends of the screw-axle "r"; then revolve the cylinder until the pencil rests on the end of the upper line marked 12 m., and tighten the thumb screw "n."

To regulate the length of the mark, first move the armature set-screw "p" until the point of the pencil rests on the upper line marked 12 m., then (after loosening the set screw which holds down the coils) move the magnet by means of the set screw "q" until the pencil mark is a little less than one-eighth of an inch long. *The mark should never exceed one-eighth of an inch.*

Care must be taken in adjusting the armature spring, so that it will not be too strong for the magnet, and still strong enough to draw back the pencil in a straight line.

The pencil should be kept pointed enough to give a clear distinct mark.

The clock should be wound every day, when the record is changed.

The record should be changed daily, at 12 o'clock noon.

At stations furnished with this self-recording apparatus, the hourly velocity of the wind or the three telegraphic reports will be deducted from the record of the half hour immediately preceding the time of observation.

LA CLANCHE BATTERY.

39. Place two ounces sal ammoniac in each glass jar, fill in with water to the depth of 1 inch, let the salts dissolve one hour, then set in the porous cups and the zincs. The glass jars should then be JUST HALF FULL, AND NEVER MORE THAN THIS. Then connect the zinc of one cell with the carbon of the next. Connect the zinc of the last with the carbon of the first, and let them stand six hours; then loosen the last connection and attach the wire from screw-cup "k" to one-pole "m" and the wire "d" (from the Robinson anemometer) to the other pole "i."

The battery, after being set, must not be shaken, and moved as little as possible.

The solution should be saturated, i. e., as much sal ammoniac as the water will dissolve. It will probably be necessary to pour in one or two teaspoonfuls of sal ammoniac every four or five months.

Keep the cells from one-third to one-half full of water, by pouring it down the outside of the porous cup. The water must not be allowed to freeze.*

* This form of battery having proved unsuited in this connection has been replaced by the Daniell's battery.

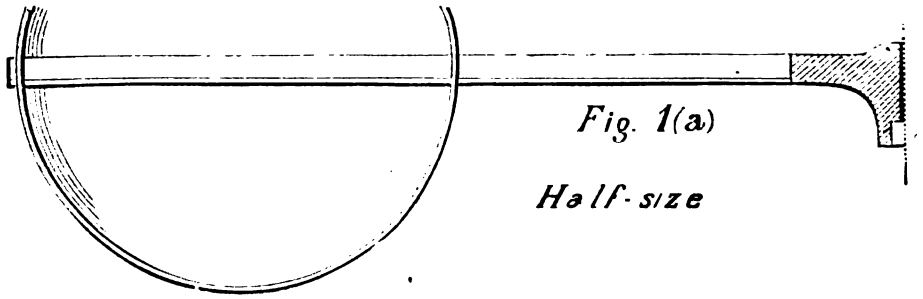


Fig 1 half-size.

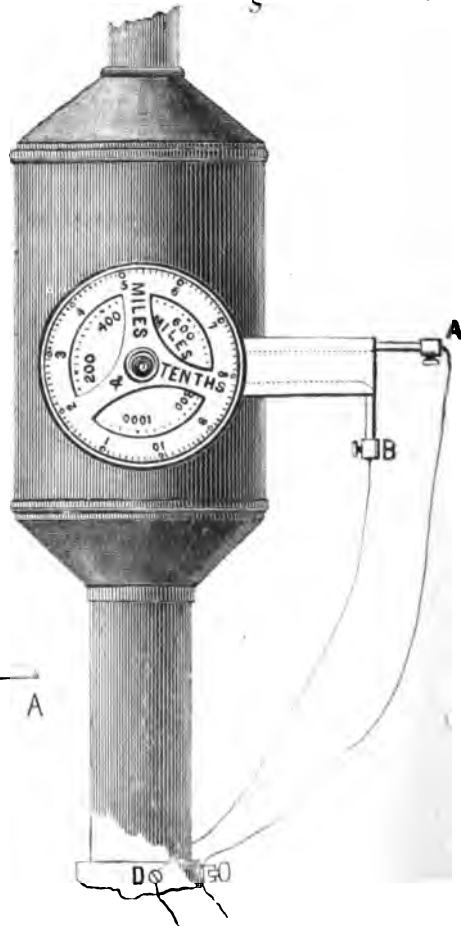


Fig 1(b)

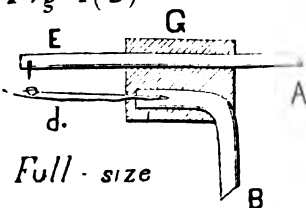
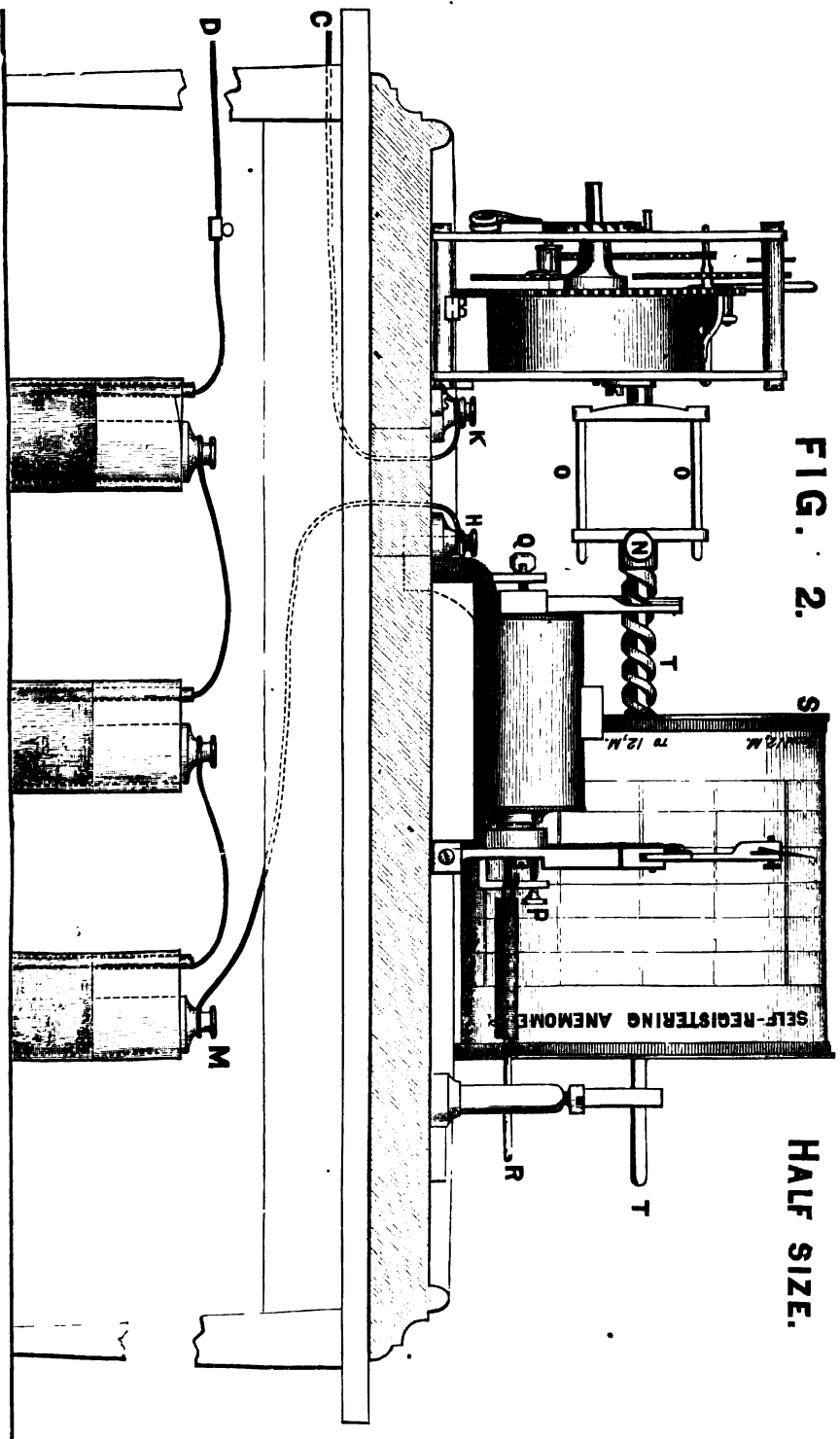


FIG. 2.

HALF SIZE.



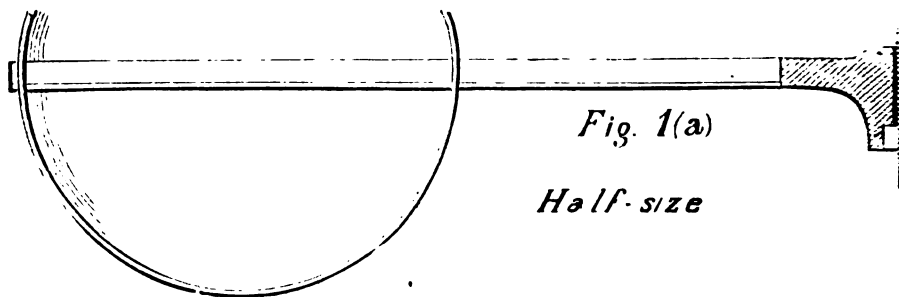


Fig 1 half-size.

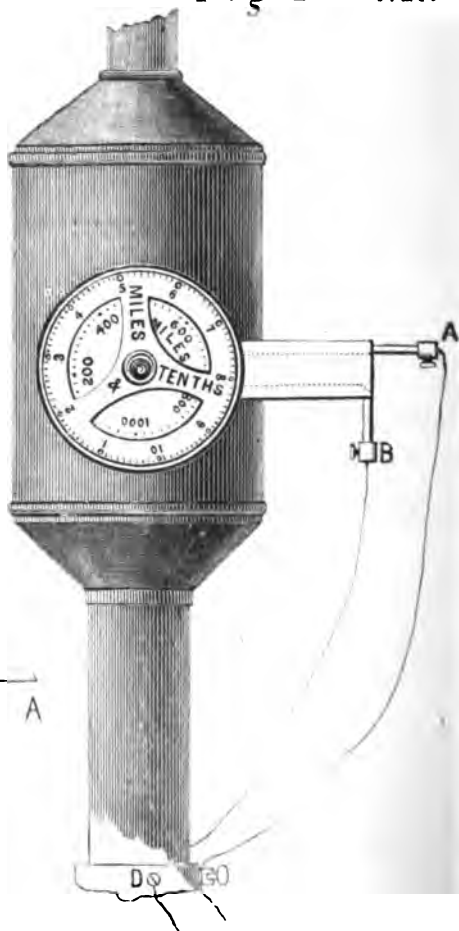


Fig 1(b)

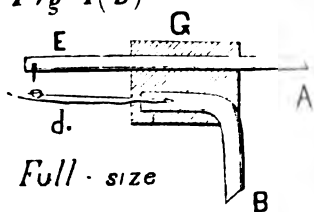
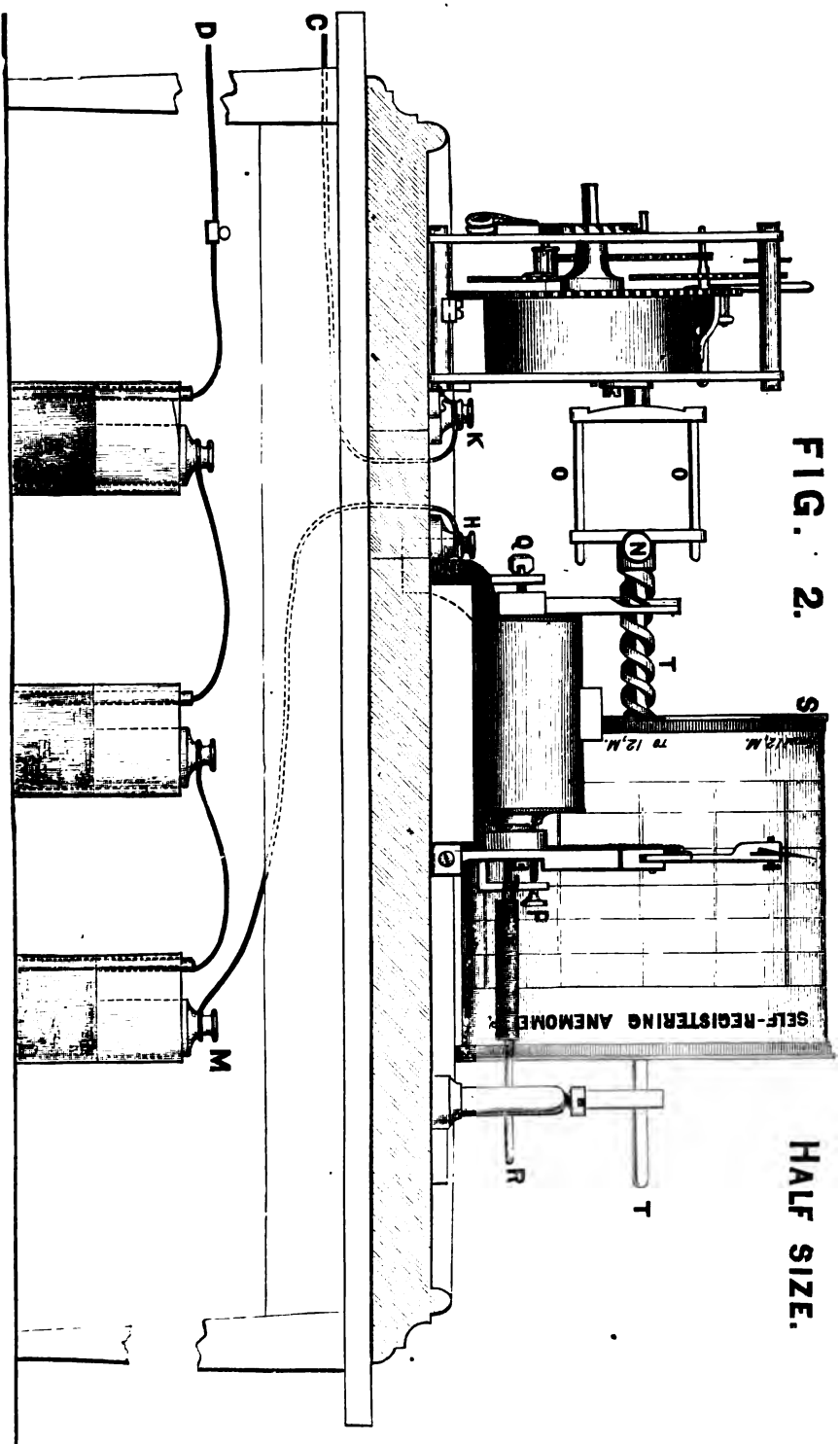
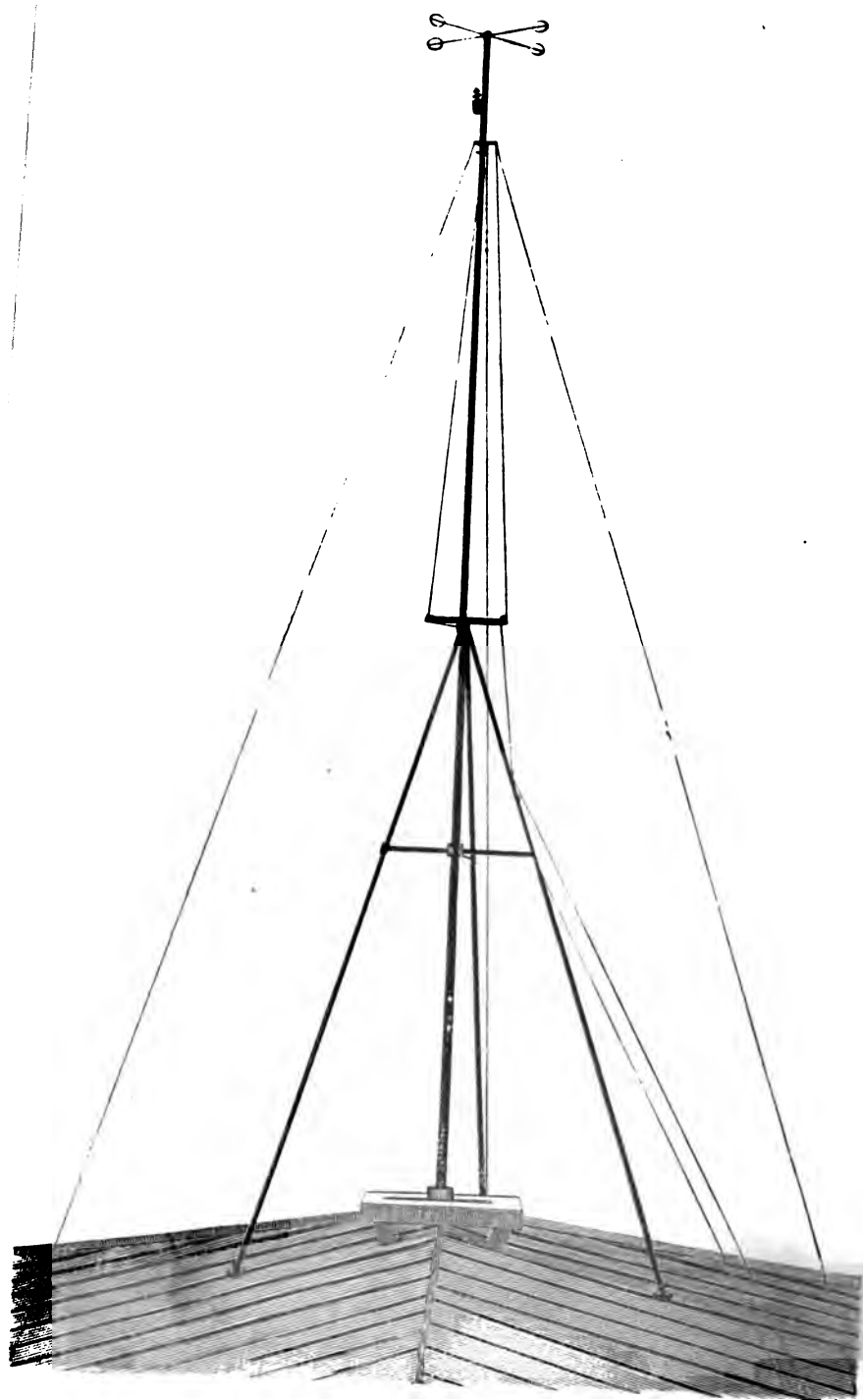


FIG. 2.

HALF SIZE.







WIND-VANE.

40. Two wind-vanes will be furnished at each station; one small one to be sent with the observer for immediate use upon his arrival, and one large one to be sent as soon after the station is opened as practicable. When the latter is received the small one will be removed and carefully stored by the observer for use in cases of emergency.

41. The vane used for getting the direction of the wind must be set in a place as free and open as possible, in order that the wind may act freely upon it, and must never be sheltered by surrounding buildings or other objects. When the small one is used, observers will mark, with the aid of a compass, upon a wooden dial, at the base of the upright which supports the vane, the true meridian of their respective stations. The magnetic variation at Station No. — is — degrees.

42. When the large vane is received at any station it will be immediately erected upon the building in which the observer's office is located, provided the consent of the owner of the building can be obtained, and the roof is strong enough to support its weight.

The general appearance of the vane, and the location of the several parts, are shown in the illustration herewith. The iron straps which unite the two parts of the foot-block will be taken off and the block separated before raising the vane, in order to put the iron socket holding it in proper position. After the vane is up the pieces will be fastened firmly together again by these straps. The central rod can be lengthened whenever necessary by adding a piece of the same diameter and cutting a screw-thread on both ends.

Where the office is not on the upper floor so that the rod can be brought into the room through the roof, the lower half of the rod will not be attached, but must be stored away for future use. When the office is on the upper floor the central rod will be brought into the room and allowed to project about two inches through the ceiling. The gilded arrow will then be screwed on and a circle drawn around it on the ceiling a little greater in diameter than the arrow. This circle will be divided into the eight points of compass used in the weather reports, care being taken to get the true meridian as a starting point.

When permission cannot be obtained to put up the vane the fact will be reported at once to this office.

The services of a skilled mechanic may be employed, whenever necessary, in erecting this vane.

The packing box in which the vane is received will be preserved for use in the event of its removal at any future time.

The observation of the vane requires more care than is usually given. In winds of considerable strength the vane is never at rest, or fixed in the same direction; it oscillates incessantly, and its oscillations increase in extent with certain winds and with the violence of the wind. In such cases observers must *note the mean* direction between the extremes. When the wind is too light to move the vane, and when it is calm, no direction will be given in the report, but the space will be filled with the proper cipher word for "Calm." The attention of observers is called to this matter in order to prevent them from recording the direction of the wind when it is calm. The direction of the wind will be designated by the eight principal points of the compass, beginning with the north and moving around by the eastward, and numbered from one to eight respectively.

The bearings of both vane and anemometer must be kept well and carefully oiled to prevent friction.

RAIN-GAUGE.

43. The rain-gauge will be placed, whenever practicable, with the top of the funnel-shaped collector twelve inches above the surface of the ground, firmly fixed in a vertical position, and protected from the interference of unauthorized persons. It will be examined at the time of making each of the three telegraphic observations, the amount of water it contains carefully measured by means of the graduated rod sent with each gauge, and then emptied and returned to its proper position. When a position at the level of the ground cannot be found with a sufficiently clear exposure, the gauge will be placed on the top of the instrument-room, or roof of the building occupied by the observer, who will measure the height above the ground and report it to this Office. The measuring-rod is graduated in inches and tenths of inches, and the proportion between the cylinder and funnel is as ten to one, so that ten inches upon the rod correspond with one inch of actual rain-fall, one inch on the rod to one-tenth of rain, and one-tenth on the rod to one-hundredth of rain. Snow will be melted and then measured and reported in the same manner as rain, but the fact of its being melted snow must be noted under the head of remarks, in the weekly reports, on Form 4.

CLOCK.

44. The clock will be hung upon the interior wall of the room occupied as an office, and at each station will be carefully adjusted to the standard local time.

As it frequently happens that the telegraph time differs slightly from the standard local time, each observer will be careful to note the amount of this difference, in order to avoid

confusion in filing his reports. As the time by which the observations are governed must be as nearly accurate as practicable, the observer will endeavor to arrange with the manager of the telegraph to have both clocks run together as a sure means of preventing errors.

45. Immediately after placing his instruments in position, each observer will make out and forward to the Chief Signal-Officer at Washington a full report in writing, stating the kind, size, and position of room selected; the street and number of the building in which the room is situated; the position of each instrument, and height of each above the ground, and also above the bench-mark furnished by this Office. In giving the height of the barometer the measurement will be made from the surface of the mercury in the cistern. Whenever the position of any instrument is changed a record will be made of such change, with date and amount of difference in elevation, and the facts reported at once to this Office.

In addition to this information, such other facts will be stated as will enable the Chief Signal-Officer to judge of the manner in which this part of the observer's duty has been performed.

Observers are cautioned against changing the position of any instrument without good and sufficient cause, and must report every change in elevation of six or more inches.

TOOL-BOX.

46. The following implements for cleaning and repairing instruments will be supplied neatly packed in a small box, to each station:

Two screw-drivers, one fitting the screws about the cistern, the other those about the scale of the barometer; a small glass funnel; two porcelain cups, from two to four inches in diameter; kid-skin; shoemaker's thread; white wax; chamois leather; a pair of small forceps; a small three-cornered file, and a blow-pipe.

MISCELLANEOUS APPARATUS.

47. *Printing press for weather-map.*—At stations supplied with a press for printing maps the following articles not sent with the press will be found necessary: A set of type-springs (one for each reporting station) for the rapid justification of the figures; one stick; one galley; sponge; brush; lye; sperm-cil, and benzine.

When the synopsis and probabilities are printed (and this should be done wherever there is a press) a twenty-five-pound font of pica type will be necessary, in addition to the symbols and figures furnished with the press. The synopsis should be set in a measure of twenty-eight ems wide. At stations supplied with the type-springs, the figures will not be removed from the plate after each issue, as the work can be done much more rapidly and easily by simply taking out the springs and changing only such figures as are necessary.

The figures and symbols should, however, be completely removed twice each month, and, with the plate, thoroughly cleaned. The figures can be cleaned daily in the plate by using a sponge moistened with benzine. The type used for the synopsis should be washed with lye. The ink-roller should be cleaned weekly, or oftener if necessary, and everything pertaining to the press must be kept well cleaned to prevent difficulty.

If stations are added for which the bed-plate has not been pierced, observers will have the necessary work done, being careful to get the new stations in their proper geographical position.

One copy of the map will be kept on file in the observer's office for reference, and on Saturday of each week a copy of the current issue will be mailed to this Office.

48. *Instructions for stamping manifold weather-maps.*—1. Count off from ten to fifteen maps from the top of the book.

2. Place the iron plate under the number counted out, and turn a map down upon it.

3. Place a sheet of carbon paper smoothly upon this map, and then turn down the next map, on which put another sheet of carbon, and so on alternating carbon and maps until the number to be issued is complete, leaving the last map without carbon upon it, taking care to smooth all when down.

In making three or four maps only a sheet of blotting-paper should be placed next to the iron plate and beneath the lower map.

4. Place the box of stamps at the top of the map, with each die in its proper place, and taking especial care not to allow the hands or mallet to rest on the paper, and thus mark and deface the lower maps.

5. First stamp with the symbol dies, the direction of the wind and state of weather, as indicated by the legend on the maps. Hold the die perpendicular to the map and strike it hard enough to make the impression go through all the maps without cutting the upper one. The actual amount of force required can only be learned by practice.

6. After the weather use the figure dies, taking care that the figures for one station do not interfere with those of any other. Stamp the first two figures (Thermometer) close together, the next two (Barometer, 29 or 30) one-eighth of an inch from the first pair, the last two of the barometer following closely. The last of the figures (Velocity of the Wind) are to be separated one-eighth of an inch from those for the barometer. Great care must be taken to

make the figures neat and regular in appearance, and to stamp them so they can be read without difficulty.

7. After the maps are properly stamped write with the stylus in head-line the name of station, day of week, date, and time of report, thus: "Washington, D. C., Saturday, April 20, 1872, 7.35 a. m."

WATER-GAUGE.

49. No definite form of water-gauge has been adopted, owing to the difficulty of getting one at a reasonable cost that would be adapted to the essentially different circumstances under which it must be used at the several river stations. The following description of a simple form of gauge may be useful in localities where it is difficult to get one of more scientific construction, or to be used as a temporary substitute for the latter in cases of emergency:

Take a piece of pine scantling, from $1\frac{1}{2}$ to $1\frac{1}{2}$ inches in thickness, and from 5 to 6 inches in breadth; the length varying according to the depth of water where it is to be used.

Having planed the scantling smooth, give it a heavy coat of white zinc paint, and after the paint is dry divide the scantling into feet and tenths of feet with a rule and lead pencil.

With a small brush paint the tenths of feet black, except the center and initial ones of each foot, which will be painted red and in heavier lines than the intermediate ones, thus:

Indicate each foot, with its proper number, in plain figures marked on the white surface just above the triangle.

Having thus marked the staff up to a sufficient height to insure getting the maximum high water, select a pile, or other stationary object, in some portion of the levee or wharf where the staff will be secure from being damaged or defaced by coming into contact with vessels, and where it will not be left dry by the tide. Lower the staff into the water, taking care to keep it in a vertical position until it touches the bed of the river, and then secure it to the pile by spikes.

It would be well, in selecting a place for fixing the staff, to take the angle of a pier, and having fastened a smooth piece of scantling, about the size of the staff, on the side of the pile, secure the staff to this.

When the gauge is in an exposed place, liable to be washed by the waves, advantage should be taken of the first low water to secure it from being displaced, by driving in additional spikes, or lashing it with strong cords to the pile.

Care must be taken in reading the staff when the water is rough to get the mean of the rise and fall of the waves. It would be well, after securing the staff, to determine some point of reference, so that in case it should be destroyed another one could be put up at the same height. This may be done by taking and marking some given point in the vicinity, a pile or a rock, at any given height of the water. Thus, by driving a spike or drilling a hole, and recording the height of the water, as read from the staff at the time, you have a "bench-mark," or point of reference, by which to set up another staff. It would be necessary in doing this to make a sketch of the place, giving the location of the staff and the point of reference; noting the local names of the surrounding points so that any other person could find the place from the description.

The record consists of a simple blank-book, with name of town and particular locality, and name of observer at head of each page, ruled in columns, with the headings, date, year, day of month, and the time of observation, hour and minute; the height of the water, expressed in feet and hundredths, state of weather, direction and approximate force of wind.

50. Observers, in publishing their local river reports, will give, in addition to the changes in past twenty-four hours, the height of water above some fixed point known and used by steamboat men and other interested parties.

51. The river observations must be made and reported with as much care, regularity, and accuracy as those of the barometer, and where the observer is compelled by pressure of other duties to intrust this part of his work to an assistant, he must assure himself by frequent personal inspection that it is faithfully and honestly done.

SIGNAL APPARATUS.

52. Stations ordered to display cautionary signals will be supplied with two (or more) red flags, one six feet and the other eight feet square, having square black centers one-third the size of the flag; one red signal lantern; one large flag-staff, and two sets of small staffs for use in cases of emergency. The large flag-staff must be from twenty-five to thirty feet in height, and so situated as to be clearly visible from as large a part as possible of the harbor and shipping it is designed to warn of approaching danger. The staff will be provided with halyards for raising and lowering the flags and lantern, and will be erected on the roof of some building, preferably on the one in which the office is located, unless a more desirable position is found near the office.

Everything connected with the signal apparatus must be kept in perfect order; flags mended when torn, ties sewed on, halyards renewed, lanterns constantly filled and trimmed.

and the approaches to the staff convenient so that there may be no delay in obeying all orders to hoist or lower signals.

53. Timely requisition must be made upon this office for new articles of equipment when those in use are likely to become unserviceable.

SIGNAL ORDERS.

54. Signals will be ordered up by telegraph from this Office in the words "Up signals," and will be ordered down in the words "Signals down." Signals will remain displayed until the order to lower them is received from this Office, unless telegraphic communication with the Office is interrupted and continues so for some hours after the storm has passed, in which case the signal will be lowered when the danger is over. Extreme caution must be exercised in this respect, in order not to mistake the customary lull in the center of a storm for an indication that it has passed over.

Observers must not, under any circumstances, hoist or display cautionary signals without authority from this Office.

55. Observers must immediately acknowledge by telegraph the receipt of all signal-orders, giving name of station, nature of order, and time of receipt. These acknowledgments will be addressed to the Chief Signal-Officer, and signed by the observer or assistant receiving the order. The following examples will illustrate the form of message to be used:

1.

CHIEF SIGNAL-OFFICER, *Washington:*

Chicago—Up signals received ten-forty a. m.

MACKINTOSH, *Observer.*

2.

CHIEF SIGNAL-OFFICER, *Washington:*

Detroit—Signals down received six-fifty p. m.

MANN, *Observer.*

56. At the end of each week a report, made out on Form 23, will be forwarded in the same envelope with the other weekly reports. This report will be forwarded regularly, whether orders have been received or not during the week.

The hours of duty will be so arranged at cautionary stations that one man will be in the office constantly, in readiness to obey signal-orders.

RECRUITING FLAG.

57. Each station will be furnished with one United States recruiting flag, for display on special occasions as ordered from this Office. At cautionary stations it will be displayed on the signal flag-staff, and at other stations a cheap staff, twelve or fifteen feet in length, will be procured for this purpose, and so arranged that it can be put up and taken down at pleasure.

MAP AND BULLETIN FRAMES.

58. Frames for the proper display of maps and bulletins will be furnished by this Office, and will not be purchased by the observers without special authority.

FORMS.

59. The following-named forms will be furnished for use at each station:

- Form 2—Receiving sheet.
- Form 3—Daily bulletin.
- Form 4—Weekly report.
- Form 5—Telegraphic report.
- Form 6—Receipt for property.
- Form 8—Weather map.
- Form 15—Synopsis.
- Form 16—Monthly chart.
- Form 19—Error sheet.
- Form 20—Barometrical correction.
- Form 22—Monthly mean.
- Form 24—Records of bulletins.
- Form 25—Telegraphic form.

Stations displaying cautionary signals will be furnished, in addition to the above, with Form 23, for reporting receipt of signal orders.

60. Form 2 is for the use of the telegraph operators in receiving the reports from other stations, and will be furnished by the observers in such quantities as may be required, care being taken to guard against wasteful and unnecessary use. The spaces will be filled up in regular order, commencing at the upper left-hand space and filling each space to the right in succession on the first line, and then commencing at the left-hand space of the second line, and so on until each space is filled. Observers will require the receiving operators to sign and date each sheet, and also to note the time the reports upon it were received before taking it from the telegraph office.*

After the reports are transferred to the bulletin the receiving sheets for each full report will be placed together and folded neatly in three folds parallel with the writing.

Each morning the three reports of the preceding day will be secured together so as to form a single package. At the end of each week the seven daily packages of the week will be put up in a neat package and forwarded by mail to this Office, accompanied by the error sheet.

61. Form 3 is the daily bulletin issued for public information. The several columns will be filled up from the receiving-sheet, the words and figures being written plainly and distinctly.

Before making any entries upon the manifold form, the sheets will be carefully smoothed down so that the registered lines of the several stations will fall directly over each other. If more than fifteen bulletins are to be written, it is better to make out the number in two equal parts, than to try and write them all at once, in order that the copies may all be legible.

One copy of the morning issue of the Saturday bulletin will be mailed to this office from each station.

The headings of the different columns indicate with sufficient clearness the matter to be filled in.

When any part of a report is not received, or, if received, is evidently incorrect, the word "blank" will be written in the spaces to be filled by such part.

Absence of wind, pressure of wind, clouds, rain-fall, or change in barometer, thermometer, and river, will be indicated by the figure zero.

New stations, whose names are not in the printed list, will be written in the blank lines at the bottom of the form.

62. Form 4 is the weekly report, and three copies will be forwarded to this Office at the end of each week; one copy containing the full record of the telegraphic series of observations, one the record of the local series, and the third that of the midday observations. This last will be sent in blank, if no changes have been noted of sufficient amount to call for report and record. In addition to the items called for by the headings of the different columns, observers will enter in the column of "Remarks" the weekly mean of the barometer and thermometer for the telegraphic series of observations, giving, firstly, the mean of the morning; secondly, that of the afternoon; and thirdly, that of the midnight observations.

63. Form 5 will be used for all of the telegraphic reports, and will be made out each time in duplicate, one copy for deposit in the telegraph-office, for transmission by telegraph to this Office, and the other for transmission by mail to the same place. Both copies must be filled up and signed in the manner indicated upon the form itself.

Each regular report will consist of ten words, arranged in two lines of five words each. At all stations designated by this Office as *river* stations, the afternoon report will consist of twelve words, arranged in two lines of six words each, the last word in first line being "river," and the last word in second line indicating by the proper cipher word the change in past twenty-four hours.

In filling up the form, the first space of the first line will be used for *name of station*, the second for *date* and *time* of report, the third for barometer, the fourth for thermometer, and the fifth for humidity. In the second line the first space will be used for state of weather, the second for velocity of wind, the third for upper clouds, the fourth for lower clouds, and the fifth for rain-fall. The cipher words must in all cases be written plainly and correctly. The word "blank" will be used when from any cause an observation is not taken.

The duplicate copies of the report for each day will be mailed the succeeding day to this Office from all stations having daily mail facilities. Other stations will forward as often as practicable.

64. Form 6 is a memorandum receipt for property, and will be filled up with the number and kind of articles received, signed, dated, and transmitted promptly to this Office.

Detailed instructions in reference to this form will be given under the head of "Property."

65. Form 8 is the weather map, to be printed or made out in manifold, as may be directed from this Office, and shows the direction of the wind, state of weather, height of barometer, height of thermometer, and velocity of wind at each station. The arrow is always to fly with the wind, and *not toward* it like a vane. In printing or stamping these maps great care must be exercised to make the figures and different signs correctly and distinctly.

* When the reports are received in duplicate by the operator, observers will retain the original sheets furnished them by this Office.

Observers must never allow imperfect or illegible maps to leave their offices. To insure accuracy, the printed maps, before being issued, must be carefully compared with the reports received, and if errors are found they will be corrected on the map, if the corrections can be made without disfiguring it and without rendering it illegible. If they cannot be so corrected, the whole edition will be destroyed, as it is better not to issue any map than one which is imperfect.

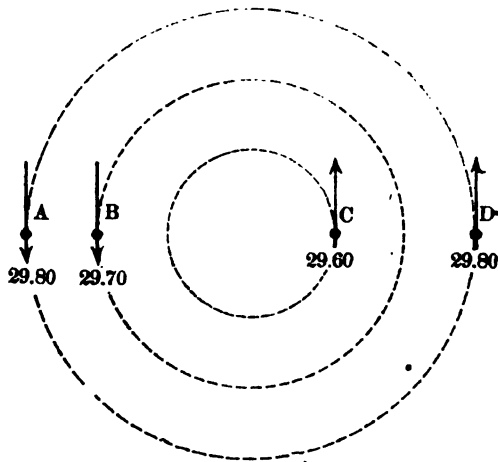
66. Observers are authorized to trace upon these maps *isobars* or lines of equal barometric pressure, in accordance with the following directions:

1st. Ascertain by a general examination of the reports, after they are entered on the map, whether any of the lines of equal pressure will, when drawn, traverse a large portion of the map, and if this is found to be the case these long lines will be drawn first. The lines of 29.90, 30.00, and 30.10, on the map, opposite page 12 of the circular issued by this Office, on the practical use of meteorological reports and weather maps, are illustrations of this principal isobar or *base line*.

2d. If decided differences in barometric readings are observed to exist between neighboring stations, enter upon the map with a red-lead pencil little dots or dashes, intermediate between any two of them, to represent the points at which the barometric reading would be exactly 29.50, 29.60, &c., or 30.00, 30.10, &c., supposing the pressure to change uniformly in the space between the two stations. The precise position of these intermediate points can usually be found with sufficient exactness by estimation with the eye.

The interpolated isobars—that is, those which are drawn between stations, as in the preceding paragraph—cannot be relied upon as perfectly accurate, but the amount of error need not exceed two-hundredths of an inch in the position of any one line, if proper attention is paid to the following points: *First*. The isobars must not be extended west of the one hundredth degree of longitude west of Greenwich, (or the meridian twenty-three degrees west of Washington,) as the barometric readings of very elevated stations cannot at present be combined with those of an altitude of fifteen hundred feet or less. *Second*. The barometrical readings reported from Mount Washington must not be used in drawing the isobars over the New England States. *Third*. Certain allowances or corrections must be made for the readings reported from several stations whose elevation is not yet accurately determined. These corrections will be furnished from this Office upon application.

When a sufficient number of dots or dashes have been made to enable the observer to trace the course of one or two of the principal isobars, they will be joined together by a curved line passing through, or nearly through, all of them, without following any of the minor irregularities that would be possibly caused by slight errors in the interpolations.



Any perplexity that may arise in drawing these lines, as to their proper route, may generally be removed by considering the direction of the wind as reported from each station. Thus, if from stations A, B, C, and D, reports are received as shown in the figure, it would be seen at once that between B and C there was a central area of low pressure around which the wind circulated in the direction indicated by the arrows, and the isobars would therefore be drawn as shown by the dotted lines.

When the lines are very much crowded together, as happens in a few severe storms, the isobars may be drawn for every two-tenths of an inch, instead of every one-tenth.

Each isobar should be plainly marked at its extremities with the figures indicating the corresponding pressure, and the central areas of highest and lowest pressure should be

marked "high" and "low," respectively, unless by so doing the appearance of the map would be injured by the complication of the lines.

When the observer has any doubt as to the course of a given isobar, he should omit it entirely or simply indicate its probable position by a broken instead of a full red line. Observers will forward to this Office weekly examples of their isobaric maps, and will not post them in any public place until officially authorized to do so.

66. Form 15 is for the synopsis and probabilities, and a copy properly filled will be posted with each bulletin at all stations where they are received. The midnight synopsis will be used with the morning bulletin, and the morning synopsis with the afternoon bulletin, whenever practicable. At stations where the afternoon and not the midnight synopsis is received, this will be used with the bulletin of the next morning.

In all cases the time and date of issue from Washington must be plainly written upon the form.

67. Form 16 is the blank meteorological chart to be made out monthly at each station, and forwarded by mail to this Office as soon after the close of each month as practicable.

The following instructions, taken in connection with the illustration given in the annual report of the Chief Signal-Officer for 1871, will enable observers to make them out properly:

For the thermometer, take the weekly reports on Form 4, beginning with the morning report of the first day of the month; with a sharp pencil make a dot on the chart at the height at which the dry-bulb thermometer stood at 7 a. m., (or the first observation,) at its 7 a. m. relative distance from the 12 m. line, as shown in the illustration referred to. Do the same with each of the six observations. Join these dots with the pencil and afterward trace with ink.

Continue the same way with the wet-bulb thermometer, barometer, and velocity of the wind, marking the direction of the wind in small letters opposite each observation.

The relative humidity and amount of clouds are given at the 2 o'clock observation—the space between the central horizontal dark lines being 100 per cent. for humidity, and the squares for clouds being 1, 2, 3, and 4-4ths, respectively.

The dark lines for rain are placed with the right edge at the point where the rain ceased. The scale may be changed for a greater fall of rain than 1½ inches, or a greater velocity of wind than 35 miles per hour.

Different colored ink may be used for the several lines, if preferred.

In forwarding these charts by mail they should never be folded, but rolled around a central core of paper or wood, the latter being preferable. As they are intended for future reference, care should be taken in making them out accurately and neatly.

68. Form 19 is the error sheet, which accompanies the weekly packages of Form 2 sent by observers to this Office. It will be filled up in the following manner:

In the 3d column will be entered the official numbers of all regular reports missing when the telegraphic circuits are closed. In the 4th, 5th, and 6th columns will be entered, on the same line under appropriate headings, the numbers of all reports of previous dates which may have been received during the time designated at the left hand of the form. In the 7th column the time the last report was received will be noted. Receipt of duplicates, corrections, and reports not in schedules, causes of delay, &c., will be noted in the column headed "Remarks." The number of words must include all reports due at the station which may have been received up to the time the circuits were closed, whether they were of the current or previous dates. Duplicates and corrections are not to be counted. *Each line of the form must contain a complete record of the work for the date and time specified.* The record will be made up from Form 2 immediately after each report.

69. Form 20 is for the weekly example of the manner in which the observer works out the barometrical corrections and deduces the relative humidity from the readings of the wet and dry-bulb thermometer.

70. Form 22 is used for the record of the daily and monthly means of the barometer and thermometer, with the prevailing direction of the wind and amount of rain-fall for the month.

In filling up this form the means of the barometer and thermometer will be obtained by dividing the sum of the 7 a. m., 2 p. m., and double the 9 p. m. observations, by four. The telegraphic observations will not be used.

Copies of this form, properly filled up, will, at the end of each month, be furnished by observers to as many of the newspapers and other periodicals, published at their stations, as may desire to make use of it. One copy will also be forwarded to this Office, and one kept on file in the observer's office.

71. The weekly mean of the telegraphic observations of the barometer and thermometer will be obtained in the following manner: Divide the sum of the a. m. telegraphic observations by the number of observations, and the quotient will be the mean of the morning observations; proceed in the same manner for the afternoon and night observations, and enter the quotients separately under the head of "Remarks," on Form 4.

The monthly mean of the telegraphic observations will be obtained in the same manner, and forwarded at the end of each month to this office, on a separate form, which will be ruled by the observers until otherwise supplied.

The local observations made at 7 a. m., 2 p. m., and 9 p. m., will not be used in getting this mean.

ILLUSTRATIONS.

Barometer; telegraphic observations, 7.35 a. m., 4.35 p. m., and 11.35 p. m., Washington mean time.

A. M.	P. M.	Midnight
30.04	30.04	30.08
30.09	30.11	30.06
30.09	30.00	29.89
29.83	29.76	29.70
29.76	29.83	29.96
30.04	29.96	29.89
29.85	29.66	29.60
<hr/> 7)209.70	<hr/> 7)209.36	<hr/> 7)209.18
29.957	29.908	29.883

Mean of a. m. observation	29.957
Mean of p. m. observation	29.908
Mean of midnight observation	29.883

Thermometer; telegraphic observations, 7.35 a. m., 4.35 p. m., and 11.35 p. m., Washington mean time.

A. M.	P. M.	Midnight.
24	37	32
32	42	32
27	47	38
40	46	40
34	32	24
23	42	38
34	61	52
<hr/> 7)214	<hr/> 7)307	<hr/> 7)256
30.6	43.8	36.5

Mean of a. m. observation	30.6
Mean of p. m. observation	43.8
Mean of midnight observation	36.5

72. In calculating the mean of the thermometer-readings at low temperatures, the following rule will be observed:

"When minus-readings occur, the difference between the sum of the positive and the sum of the negative numbers is to be taken. This difference, which is the TOTAL SUM, has the sign of the greater of the two partial sums, and will be divided by the TOTAL number of observations."

The quotient obtained by this division will be the mean sought.

The following are examples:

Example 1		Example 2.	
	+ 70		+ 60
	+ 50		+ 20
	+ 20		0
	0		- 5
Sum of positive.....	+ 140	Sum of positive.....	+ 80
Sum of negative.....	0	Sum of negative.....	- 5
Total sum.....	+ 140	Total sum	+ 75
Number of observations.....	4	Number of observations.....	4
Mean.....	+ 35	Mean.....	+ 18.75

Example 3.

	+	2
	—	5
		0
	+	4
	—	7
	+	5
	—	15
<hr/>		
Sum of positive.....	+	11
Sum of negative.....	—	27
<hr/>		
Total sum.....	—	16
Number of observations.....		7
Mean.....	—	2.3
<hr/>		

Example 4.

	—	5
		0
		0
		0
		0
		0
<hr/>		
Sum of positive.....		0
Sum of negative.....	—	5
<hr/>		
Total sum.....	—	5
Number of observations.....		6
Mean.....	—	0.8
<hr/>		

73. Form 23 is for use at stations designated for the display of cautionary signals, and will be filled up and forwarded weekly to this Office during the period signals are ordered. Under the head of "remarks" will be recorded the highest velocity reached by the wind during the time the signals were displayed.

74. Form 24 is the weekly report of the number of bulletins and maps issued at each station, and will be forwarded to this Office in the same envelope with the other regular weekly reports.

75. Form 25 is the one upon which all official telegrams to this Office must be written. As everything transmitted is charged for, unnecessary words must be avoided. The full date and time of filing message will be written *above* the upper heavy line, while only the name of the city and the day of the month will be written below it. The signature must contain only the surname of the sender and the word "observer." Only the matter written between the heavy lines is to be transmitted.

BOOKS OF REFERENCE AND RECORD.

76. The following books of reference and record will be furnished by this Office to each station:

For reference.—Guyot's Meteorological Tables; Buchan's Handy Book of Meteorology; Loomis's Treatise on Meteorology; Myer's Manual of Signals; Piddington's Horn-Book; Pope's Modern Practice of the Electric Telegraph; Annual Report of the Chief Signal-Officer for 1871; Practical Use of Meteorological Reports and Weather-Maps; Instructions to Observer-Sergeants, Signal-Service, United States Army; Smithsonian Directions for Meteorological Observations.

For records.—Journal; Daily Record of Observations; Record of Bulletins; Record of Letters Sent; Record of Letters Received; Original Record of Observations; Weather-Map of the United States.

77. In the journal will be entered, daily, all matters of interest not provided for in the various forms, such as meteoric and auroral displays, earthquakes and unusual atmospheric appearances and disturbances, giving in all cases, when possible, the time of beginning and duration of each. Especially will the observer enter a detailed account of the characteristic phenomena of every serious storm that passes over or near his station. In this book will also be noted the condition of the instruments, and when they are damaged, in any way, the cause will be stated. A monthly abstract of the entries in the journal will be forwarded to the Chief Signal-Officer within five days after the expiration of each month.

78. Observer-sergeants will be particular to note every display of aurora, seeking, by inquiry of others, if necessary, to make their record complete.

If the heavens are obscured by clouds so that the aurora, if present, cannot be observed, the word "obscured" will be entered in that part of the record devoted to auroral displays. If the sky is sufficiently clear for observation, the words "aurora" or "no aurora" will be entered according as one is visible or not. When observed, a full account of the phenomenon will be entered in the journal, showing the exact minute of beginning and ending of the aurora, and the principal phases of changes that it experiences. The following particulars, should be especially noted: the azimuth and altitude of each extremity and of the crown of any arch of light and the same data for any corona or glory that may be formed.

When the observer is familiar with the names of the principal fixed stars, he may locate the arch or crown by reference to them; but it is preferable that he should observe directly the altitude and azimuth.

Altitudes are expressed by degrees from the horizon to the zenith. If any circle be divided into 360 parts, and radial lines connect these parts with the center, each pair of lines subtend an angle of one degree; the fourth part of the circle will subtend an angle of ninety degrees, or one right angle, and the corresponding radii are perpendicular to each other. Thus, the zenith (that point in the heavens immediately above the observer) is ninety degrees from the horizon, or, in other words, its altitude is ninety degrees.

A point half way up from the horizon to the zenith has an altitude of forty-five degrees. Azimuths are also expressed in degrees, but are measured on the horizontal plane, and will be recorded as is done in astronomy, from the south point to the westward, passing successively the west, north, and east points of compass until 360° have been passed over and the south point is again reached.

Observers must be particular as to the date of the aurora, and when it begins in the evening of one day and continues into the early morning of the next day it will be entered as occurring on the *first* day; but its details will be given in the record as occurring between the hours of its actual beginning and ending. Thus, an aurora that began on the evening of the 12th of January, and continued until the early morning of the 13th, would be entered as the aurora of the 12th, but its details would be recorded as occurring, for instance, between the hours of 10 p. m. of January 12 and 2 a. m. of January 13.

All entries in the journal of occurrences and observations of any one day will be made under or opposite to that day, and not be entered as a subsequent date as is frequently done. For example; an auroral display occurring May 23, should be entered opposite that date, and not referred to on the 24th, as having occurred "last evening."

Observers must pay particular attention to accuracy in the use of the terms "morning" and "evening," and will be governed by the following instructions in reference to them:

Midnight is the moment 12h. 00m. 00s., and is the beginning or first moment of the new day, and should receive the date of that day. Thus, whatever happened in the afternoon of June 10, at 11h. 59m. 59s., happened at 11h. 59m. 59s. p. m. June 10; whatever happened one second later was at midnight of June 10 and 11; and at one second later still, at 12h. 00m. 01s. a. m. of June 11; at midday of same date whatever happened at 11h. 59m. 59s., happened at 11h. 59m. 59s. a. m. June 11; at one second later it was noon June 11; at one second later still it was 12h. 00m. 01s. p. m. June 11.

79. The daily record of observations will be an exact copy of Form 4, and filled up in the same manner. The several series of observations can be entered in the same book, care being taken to date and time them properly. The telegraphic series may be entered in the beginning of the book, and the local series at the end, while the midday reports may follow either of the two.

80. The record of bulletins will be filled up regularly from the daily bulletins, of which it is a copy.

81. In the books of letters sent and letters received will be entered all letters sent, and an abstract of all those received relating to the official business of the station. The original letters received will be properly briefed and numbered, and filed away for reference. The numbers used will correspond with those in the letter-book.

82. The large weather-map of the United States will be hung up in the principal room of the board of trade or chamber of commerce, or both, and the state of the weather throughout the United States will be shown upon it in the manner already described, as soon after the receipt of the morning report as is practicable.

83. All books of reference and record must have the *name* of the station to which they belong plainly written on the fly-leaf.

GENERAL INSTRUCTIONS.

84. Each observer in charge of a station will, as soon as practicable after arriving at his station, make arrangements with some competent person to perform his duties in case of sickness or disability. The person so selected must be carefully instructed in the use and care of the several instruments, in the manner of taking the observations, of making out and forwarding the weather reports sent from the station, and the proper disposition of those received from other stations. His name and regular post-office address will be reported to this Office as soon as the selection is made. The employment of this assistant will be temporary only, and he will be paid at the end of each month in which the services were rendered, at the rate of compensation fixed by the Chief Signal-Officer, on forwarding the proper vouchers to this Office, with a certificate from the observer-sergeant stating the number of days employed, with the dates in each case.

85. In case of sickness or disability rendering an observer or assistant observer incapable of performing his duties, the observer in charge will report the fact by telegraph to the Chief Signal-Officer, and will forward by mail the certificate of his attending physician.

86. At stations where there is no medical officer, a resident practitioner will be employed, whose account, made out in duplicate, on the form given below, together with the prescriptions when medicines have been required, will be transmitted for payment to the Surgeon-General of the Army, through the office of the Chief Signal-Officer, Washington, D. C.

Bills for articles of food, or diet of any kind, liquors, wines, mineral waters, patent or proprietary medicines; instruments or appliances, such as syringes, trusses, or suspensory bandages, will not be allowed by the Medical Department.

When the services of a nurse are necessary, a separate bill for the nursing will be made and certified in the same manner as that for medical attendance.

The UNITED STATES,

To _____, M. D., DR.

For medical attendance furnished to _____, suffering from _____ at _____ from _____ to _____ \$ _____

For medicines as per accompanying prescriptions \$ _____

I certify that the above account is correct and just; that the services were rendered as stated and were necessary; and that the charges do not exceed those customary at this place.

Subscribed and sworn to before me, this _____ day of _____, 187—, M. D.

I certify that the above account is correct and just; that the services were rendered as stated, and were necessary; that I was on duty at _____, and could not secure attendance from a medical officer of the Army.

Observer-Sergeant, Signal Service, U. S. A.

Sworn to and subscribed before me, this _____ day of _____, 187—

Approved:

Brigadier-General and Chief Signal-Officer of the Army.

When the attendance has been to an assistant, the form will be altered accordingly, and the account forwarded through the sergeant in charge, who will indorse his remarks upon it, and inclose in letter of transmittal to this Office.

87. At stations where there is a medical officer of the Army on duty, observers will be duly notified, and provided with authority to call on him for medical assistance. When medicines are not furnished directly by the medical department, but through a druggist, on the prescription of a medical officer, and the bill of the druggist is presented to the patient, that bill in duplicate, approved by the medical officer and receipted, will be attached to an account made out in the name of the patient, the above form being altered according to the facts, and the only sworn certificate necessary being that of the patient.

88. At all stations where there is a private soldier on duty as assistant, the observer-sergeant in charge will give especial attention to his instruction in the theory, as well as in the practice, of meteorology, signalling, and telegraphy.

In order that this may be properly done, the sergeant will require his assistant to give a recitation each week from one of the following-named text-books, going through them in the order given: Loomis's Treatise on Meteorology; Myer's Manual of Signals; Pope's Modern Practice of the Electric Telegraph, until satisfied that the subject is thoroughly understood, or that the assistant is wanting in capacity to understand it.

The ordinary station work will be fully explained, and the reasons for each instrumental correction given in detail. A brief weekly report will be made to this Office, showing the nature of the instruction given and progress made during that period.

This duty must be carefully and faithfully performed, in order that worthy men may receive the promotion due them, and unworthy ones be disposed of.

No application from assistant observers for promotion to the grade of sergeant will be favorably considered until this course of instruction has been completed in a satisfactory manner, and is so reported by the observer in charge.

The instruction will extend through the work on meteorology; to page 96 of the Manual of Signals, and to page 72 of the work on telegraphy.

89. In the absence of serious special reasons or exigencies of the service, no applications for examination before the board of examiners at this Office for promotion to the grade of sergeant will be favorably considered, except when made by enlisted men of the Signal-Service Detachment, United States Army, who shall have performed satisfactorily the duty of assistant to an observer-sergeant on station, or similar duty at this Office, for a period of six months. Such applications, by men on duty as assistants, must be made in writing, through the observer-sergeant in charge of station, (who will in all cases indorse his report of the character, habits, and ability of the applicant,) and will be acted upon by the board when vacancies exist in the authorized number of observer-sergeants.

90. The publication of the Government weather-reports by newspapers must be done without expense to the United States.

91. Observers will select such places for posting the daily weather bulletins and maps as will insure their widest publicity at all hours of the day or night, and will report the names and locations of the places thus selected to the Chief Signal-Officer. At the same time, they will report the location of their own offices, giving name of street and number. This information will also be furnished to the manager of the telegraph-office charged with the transmission and receipt of the reports.

92. Observers must not make use of the telegraph in communicating with the central office in Washington, except in cases of the utmost importance. Where the use of the telegraph is considered unnecessary by the Chief Signal-Officer, the cost of the telegram will be charged against the observer sending it.

93. Communications to this Office on official business will be written on the official size of letter-paper, inclosed in an official envelope, and directed to "The Chief Signal-Officer of the Army, Washington, D. C." The words "official business" will be written on the right-hand upper corner of the envelope. Letters thus addressed and indorsed are free of postage.

94. Half sheets of paper will be used in all cases in which letters are completed on the first page. When more than one page is required, a whole sheet will be used.

95. Communications written on letter-paper will be folded in three equal folds; on foolscap or legal-cap paper, in four equal folds, parallel with the ruling. Observers must not brief any official letter to this Office, and must give the full names of all persons referred to.

96. All official communications received by observers, wherever serving, from parties not connected with the signal-service, will be immediately referred to this Office for such action as may be considered necessary.

97. No reports or letters containing information in reference to the signal-service will be made or sent to any person or persons by observers on station until such reports or letters have been submitted to and approved by the Chief Signal-Officer.

98. Observer-sergeants will comply with the Regulations of the Army, and wear their uniform-coat buttoned up while on duty. They are required to be especially neat and careful in their dress; and any negligence in this particular coming to the knowledge of the Chief Signal-Officer will be considered sufficient cause for the reduction of the offender to the rank of a private soldier.

99. Observer-sergeants will not comprise in the same communication matters relating to their meteorological observations and general details of duty with those relating to property received or disposed of, commutation or pay vouchers, bills, or any other particular involving money or property accountability.

Letters of transmittal, application, or explanation, under these two general heads, must be written on separate sheets of paper, but may be sent in the same envelope as a matter of economy.

100. Observers will give close attention to the observation and record of all local premonitory signs of storms or changes of weather, and report them promptly to this Office. The following points should be particularly noted: Direction and force of the wind; kind, direction, motion, and appearance of the clouds; action of the barometer and thermometer before, during, and after a storm or change of weather, and such other purely local causes as appear to influence the results.

101. The attention of observer-sergeants is directed to the fact that they are required to make their reports absolutely correct, and that any shortcoming in this respect renders them liable to punishment. Aside from this, it should be kept constantly in mind that a single incorrect report may cause the loss of life and property to an unknown amount, and all reports must be made with this responsibility clearly in view. Whenever an observer is unable, from any cause, to get in his report, properly corrected, at the regular hours of report, he will *not* send the uncorrected portion, but will write the word "blank" in each of the spaces that would otherwise have been occupied by this portion of the report. Observers will *never* send any report or part of report which they have reason to believe is incorrect, and will bear in mind that it is safer and more in accordance with instructions to omit a report than to make a false one.

102. In the event of one or more instruments at a station becoming disabled and unfit for use, observers will fill up the space or spaces in the different forms intended for the readings of such instruments with the word "blank," until they are repaired or replaced. If the instruments cannot be properly repaired at the station, the observer will at once notify this Office.

103. Observers are expected and required to improve themselves in the duties of their position, and are liable at any time after one year's service to be called before a board for their second regular examination.

104. On the first days of January and July (or within ten days thereafter) of each year, every observer-sergeant in charge of a station will make out and forward to this Office a concise statement of the operation of his station for the preceding six months. This statement must show the changes (if any) that have been made, and the number of reports received, during that period, with the reason for such changes when known. It will also show the amount of public interest taken in the service, and the classes of citizens deriving the greatest amount of benefit from the reports. If any marked advantages to commercial or other interests have been derived from the use of the reports or display of cautionary signals, the facts in each instance will be briefly set forth.

105. Observers in charge of stations will mail, on Saturday of each week, a copy of that morning's issue of every daily newspaper published at their stations, which contain the weather reports in any form.

106. All applications from observer-sergeants or assistant observers of the signal-service,

U. S. A., for furloughs, or official privileges of any description, must be made directly to the Chief Signal Officer of the Army.

In cases of urgent necessity such application may be made by telegraph, but in all ordinary cases will be in writing, and forwarded by mail.

107. All communications to this Office from an assistant observer must be forwarded through and indorsed by the observer-sergeant in charge of the station at which he is serving.

PROPERTY.

108. Blank forms entitled "Report of signal-service property," will be furnished to each observer for making out a quarterly report of the property at his station, which report will be rendered at the expiration of the quarters ending, respectively, March 31, June 30, September 30, and December 31, of each year.

This report will be filled out in the following manner: All property received from this Office, and purchased at the station by proper authority from this Office, will be entered on the line containing the words "Total during quarter."

109. Bills for all properly authorized purchases must be forwarded to this Office so as to reach it as near the first day of each month as is practicable.

On the line headed "Issued and expended during the quarter," will be entered in the proper columns the total expenditures of forms, stationery, &c., consumed in performing the regular duties of the station during the quarter, with such articles as may have been returned to this Office. These will be deducted from the amounts in the line beginning "Total during quarter," and the remainders brought down and entered on the line "Total on hand to be accounted for," which completes the first report from any station.

Each quarterly report will be made in duplicate, one copy to be transmitted to this Office within ten days after the expiration of the quarter, and the other retained by the observer making it out, to enable him to bring forward for next report the "Total on hand to be accounted for," which will be entered in the next report as "On hand from last report."

No article will be entered in this report that is not invoiced from this Office.

Every article taken up on this report must be entered under its proper heading, as the misplacement of a single figure may occasion serious difficulty. Before the report is sent in the two copies should be carefully compared in order that they may be made to correspond exactly with each other.

110. When an observer is relieved from the charge of a station, he will turn over, on proper invoices, to his successor all property and stores for which he is officially responsible, and will take duplicate receipts therefor, one copy of which he will retain, and forward the other to this Office with a final report, on the regular form, of the property for which he was accountable, at the date of his relief, made out in precisely the same manner as the regular quarterly report.

One copy of the invoice of property so transferred will be forwarded to this Office by the observer taking charge.

111. When public property is receipted for by an observer he will make a careful examination of it, and forward a written report of the result of such examination to this Office.

112. Whenever any article of office furniture, stationery, &c., is purchased by an observer, under proper authority from this Office, it will be entered in a copy of Form 6 as "Received by purchase," with the name of the party furnishing it, and a memorandum bill of the price paid or to be paid, and forwarded to this Office, properly dated and signed, by mail on the day of purchase.

113. Authority must be obtained from this Office for making all repairs and purchases at stations, except those enumerated in paragraph 119 of these instructions, and all applications for such authority must set forth the necessity for the expenditure, and state the estimated amount.

114. No public property will be used or labor employed by observers for any purpose whatever, without special authority from this Office.

115. When any article of public property, not of an expendable nature, for which an observer is responsible, becomes unfit for service, from any cause whatever, he will report the facts in the case to this Office, but will not drop such article from his returns until authorized to do so.

116. Observers will endeavor, by timely repairs, to keep all property for which they are responsible in serviceable condition, and necessary funds for this purpose will be provided, upon satisfactory requisition and estimates forwarded to the property and disbursing officer.

117. If any article of public property be lost or damaged, through the neglect or fault of any observer or assistant, the money value thereof will be stopped against his monthly pay.

118. A rigid economy must be practiced by all observers in the expenses of their several stations, and all irregularities and extravagances will be promptly corrected by charging all excesses to the observers at fault.

119. The following articles will be allowed at each station, and may be purchased at the places named, by each observer, without other authority:

One room for the performance of his duties will be rented by the month, at each station, but no more than eighteen dollars per month will be paid therefor without special authority

from this Office; one desk, (price not to exceed \$20;) one table, with drawers, (stained pine and not to exceed \$6;) one wash-stand, (at a price not exceeding \$2;) four chairs, (not to exceed \$2.25 each;) one stove, with pipe, (not to exceed \$25;) one coal-scuttle; one fire shovel; one water-bucket; one cup or dipper; one goblet; one basin; one large lamp; one oil-can; one dust-pan and brush; one broom; two common spittoons; one lantern. The above-mentioned articles must be of a cheap, plain, and substantial kind. Memorandum bills (unreceipted) for rent, labor, and purchases will be sent to this Office as soon as presented, and will be settled at the earliest opportunity.

120. Memorandum bills for labor and for articles purchased must be sent in separately.

121. Fuel will be purchased for heating office, by each observer, at the current market rates, and bills forwarded to this Office for settlement. The cost of carrying coal and other fuel to the observer's office will be included in the price of the fuel, and not charged as a separate item.

122. The pay and allowances of observer-sergeants and enlisted men serving as assistant observers, are obtained from three different sources, and will be drawn through the property and disbursing officer of the Signal Service, United States Army, at the end of each month, on the receipt at this Office of the following blanks, signed in duplicate:

1st. Form 5—Pay Department.

FORM 5.

The UNITED STATES,

To JOHN THOMPSON, DR.

	Dollars.	Cents.
For pay from 1st of ———, 187 , to — of ———, 187 , being ——— months. — days, at ——— dollars per month.....		
Amount		
Deduct for Army Asylum	\$ —	
Due United States for clothing overdrawn.....	—	
Due United States for tobacco.....	—	
Balance		

Received of ———, paymaster United States Army, this — day of ———, 187 , ——— dollars, in full of the above account, by check No. ———, on ———, United States Treasurer, ———, this date, for \$——.

JOHN THOMPSON,

Sergeant Signal Service, United States Army.

(Signed in duplicate.)

This payment accords with the soldier's descriptive list, and is noted thereon.

Paymaster, United States Army.

2d. Form Y—Commissary Department.

(FORM Y.)

The UNITED STATES,

To JOHN THOMPSON, *Sergeant Signal Service, U. S. A.*, DR.

	Dollars.	Cents.
For commutation of rations while on extra duty as —, at —, from — to —, 187, inclusive, — days, at 75 cents per day.		

I certify that the above account is correct and just; that the commutation was made by order of the Secretary of War, and was necessary for the public service, there being no opportunity for messing.

Received at —, this day of —, 187, from —, C. S., United States Army,
the sum of — dollars and — cents, in full of the above account.

(Signed in duplicate.)

JOHN THOMPSON,
Sergeant Signal Service, U. S. A.

31. Signal Service receipt-roll—Quartermaster's Department.

(Voucher to Abstract B.)

We, the subscribers, do hereby acknowledge to have received of _____, Quartermaster, — U. S. Army, the sums set opposite our names, respectively, being in full of our extra-duty pay and allowances for commutation of quarters and fuel for the periods herein expressed, while stationed at _____.

Date of payment.	Name.	Rank.	Occupation.	Period of service.		Extra duty.		Quarters.		Fuel.		Total amount received.	Signatures.	Witnesses.
				From—	To—	Months.	Days.	Rate per month.	Amount.	Rate per month.	Amount.			
	John Thompson Henry Smith	Sergeant Private						Dolla. Cts.	Dolla. Cts.	Dolla. Cts.	Dolla. Cts.		John Thompson Henry Smith	
Total.....														

I certify that the above roll is correct; that the enlisted men therein named have been regularly on duty at _____, during the time charged for; that they have not been furnished with quarters or fuel by the public, or received a commutation of money in lieu thereof, and that the services are borne on my Form 3 for the month of _____, 187 .

(Signed in duplicate.)

These vouchers will be signed by observers and their assistants exactly as shown in the above illustrations.

123. *No part of the body or receipt of either form will be filled up before transmission, and they must be forwarded direct to this Office at such time as will insure their receipt by the property officer by the 25th of each month.*

124. Observers will not be allowed to sell or otherwise dispose of any of the above-mentioned accounts, nor will they be permitted to draw upon this Office, or any of the officers connected therewith, without special authority.

125. The following tables show the amount of monthly pay to be received by observers and their assistants, for the different years of service, and the sources from which it is received :

Estimate of monthly pay proper and commutation of clothing.

SERGEANTS.

Year.	Pay proper.	Clothing.	Total.	Stoppages.	Average pay per month.
First.....	\$17 00	\$4 14	\$21 14	\$0 12½	\$21 02
Second.....	17 00	2 36	19 36	12½	19 24
Third.....	18 00	3 28	21 28	12½	21 16
Fourth.....	19 00	2 36	21 36	12½	21 24
Fifth.....	20 00	2 94	22 94	12½	22 82

PRIVATEES.

First.....	13 00	4 08	17 08	1 12½	15 96
Second.....	13 00	2 34	15 34	1 12½	14 22
Third.....	14 00	3 23	16 23	1 12½	16 11
Fourth.....	15 00	2 34	17 34	1 12½	16 22
Fifth.....	16 00	2 90	18 90	1 12½	17 78

One dollar per month from pay of third year, two dollars per month from pay of fourth year, and three dollars per month from pay of fifth year will be considered as retained pay, and will not be paid until final discharge from the service, and will be forfeited unless the soldier shall have served faithfully to date of discharge.

Monthly estimate of quartermaster.

No. of days in the month.	Fuel—rate per month.	Quarters—rate.	Extra pay—rates.	Total.
28	\$8 00	\$10.00	\$10 15	\$28 15
30	8 00	10 00	10 50	28 50
31	8 00	10 00	10 85	28 85

Assistants are not allowed extra-duty pay.

Monthly estimate of commutation of rations.

No. of days in the month.	Rate per day.	Total.
28	\$0 75	\$21 00
30	75	22 50
31	75	23 25

REPORT OF THE SECRETARY OF WAR.

Estimate of monthly pay of sergeants (observers) and privates, (assistants.)

SERGEANTS.—FIRST YEAR.

No. of days in the month.	Pay proper.	Quartermaster's Dept. pay.	Commissary pay.	Amount of pay received monthly.
28	\$17 00	\$28 15	\$21 00	\$66 15
30	17 00	28 50	22 50	68 00
31	17 00	28 85	23 25	69 10

SECOND YEAR.

28	17 00	28 15	21 00	66 15
30	17 00	28 50	22 50	68 00
31	17 00	28 85	23 25	69 10

THIRD YEAR.

28	18 00	28 15	21 00	67 15
30	18 00	28 50	22 50	69 00
31	18 00	28 85	23 25	70 10

One dollar per month retained until discharged.

FOURTH YEAR.

28	19 00	28 15	21 00	68 15
30	19 00	28 50	22 50	70 00
31	19 00	28 85	23 25	71 10

Two dollars per month retained until discharged.

FIFTH YEAR.

28	20 00	28 15	21 00	69 15
30	20 00	28 50	22 50	71 00
31	20 00	28 85	23 25	72 10

Three dollars per month retained until discharged.

PRIVATES.—FIRST YEAR.

28	13 00	18 00	21 00	52 00
30	13 00	18 00	22 50	53 50
31	13 00	18 00	23 25	54 25

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Estimate of monthly pay—Continued.

SECOND YEAR.

No. of days in the month.	Pay proper.	Quartermaster's Dept., pay.	Commissary pay.	Amount of pay received monthly.
28	\$13 00	\$18 00	\$21 00	\$52 00
30	13 00	18 00	22 50	53 50
31	13 00	18 00	23 25	54 25

THIRD YEAR.

28	14 00	18 00	21 00	53 00
30	14 00	18 00	22 50	54 50
31	14 00	18 00	23 25	55 25

One dollar per month retained until discharged.

FOURTH YEAR.

28	15 00	18 00	21 00	54 00
30	15 00	18 00	22 50	55 50
31	15 00	18 00	23 25	56 25

Two dollars per month retained until discharged.

FIFTH YEAR.

28	16 00	18 00	21 00	55 00
30	16 00	18 00	22 50	56 50
31	16 00	18 00	23 25	57 25

Three dollars per month retained until discharged.

Clothing allowance per month.

	1st year.	2d year.	3d year.	4th year.	5th year.	Total allowance for five years.
Sergeants	\$4 14	\$2 36	\$3 28	\$2 36	\$2 94	\$180 96
Privates	4 08	2 34	3 23	2 34	2 90	178 68

But no clothing allowance will be paid the soldier except on "final statements." When clothing is drawn, if the allowance is exceeded it will be settled by the soldier on the 30th June and 31st December of each year.

In addition to the above rates of pay, enlisted men will receive the usual allowance for first, second, third, and fourth re-enlistments.

126 All useless and broken instruments will be forwarded to this Office by mail, carefully packed.

127 Timely requisition will be made upon the property-officer for books of record, stationery, forms, &c., to insure their receipt before the supply on hand is exhausted.

128. Requisitions for forms and stationery will be made quarterly by mail, and will embrace all the different varieties required for use at stations.

SPECIAL INSTRUCTIONS.

In case of actual or anticipated neglect or refusal on the part of the employés of any telegraph company by which he is directed to transmit telegraphic communications, at the time and in the manner stated in the orders of the Chief Signal-Officer to the observer in charge of a station, then in force, he will proceed as follows:

1. He will prepare every telegraphic communication according to his instructions, and present each, at the time designated, at the proper office of the company for the reception of such communications. He will continue to present all reports, as to the regular tender of which the company has once been advised, until it has been notified by this Office that such tender will cease after a certain date, of which notice the observer will be informed.

2. He will, in advance of the presentation of all telegraphic communications, give specific notice to the company, during its usual hours of business, that an official communication of a certain-mentioned character, from the observer, addressed to a certain official person or persons, (the address to be specified,) will, at a certain subsequent hour, (stating what hour,) be presented at the office of the company for telegraphic transmission. This notice will provide for every regular report to be made during the ensuing twenty-four hours, and also will be given in advance of any special communication when practicable. Such notice will be in writing, addressed to the local manager of the company, and will be delivered, open, to the officer or employé of the company who may be in charge of the local office at the time of delivery. The written notice will be signed in duplicate by the observer, and one copy filed and retained by him. The following general form will be observed:

"SIGNAL-SERVICE, UNITED STATES ARMY,

"Observer's Office, ———, ———, 187 —.

"To ———

"Manager of the ——— Telegraph Company, at ———.

"SIR: As an agent of the War Department for the purpose of taking meteorological observations, in pursuance of the laws of the United States, and of preparing telegraphic communications relating thereto, and of presenting the same for transmission to telegraph companies, I have the honor to give notice hereby that, in accordance with orders received by me to that effect, I will present at the office of the above-mentioned telegraph company at this place, severally, at the times hereinafter mentioned, certain official communications from myself, in my official capacity, and addressed as specified, viz:

"One communication will be presented at ——— o'clock — minutes — m. of ——— the ——— day of ———, 1872, addressed to ———

"One communication will be presented at ——— o'clock — minutes — m. of ——— the ——— day of ———, 1872, addressed to ———

"One communication will be presented at ——— o'clock — minutes — m. of ——— the ——— day of ———, 1872, addressed to ———

"I have the honor to request that the communications above referred to may be received and transmitted telegraphically by the said company to their respective addresses at the times above mentioned, at which they will severally be presented for that purpose.

"I am, sir, respectfully yours,

"—————
"Observer-Sergeant, Signal Service, U. S. A."

He will also record the time, place, and person, when, where, and to whom he delivered such notice, and reduce to writing any oral reply made or action taken. The record must be dated, timed, and made, plainly written, immediately after the service of the notice.

3. He will present his regular reports for transmission at the times, and as directed in his schedule, at the telegraph offices, until further orders, whether or not the company has any employés then present whose usual duty it is to receive them. If the office is open for his admission, although closed for the transmission of messages, the communication should be presented to the most responsible person present in the employ of the company, a copy being always retained, and record made as above directed. If the office appears to be closed, he will make himself sure of the fact that it is so.

In writing the message for transmission the observer will not use any form imposing terms or the limitations of a contract, but will write the communications tendered on the form directed by this Office.

4. He will keep a written record of the time when, place where, and the name of person employed by the company, to whom each communication was presented. In case the office was closed, so that the communication could not be presented to any employé of the company he will record the time and place with the fact. If any employé of any telegraph company refuses to receive the message presented to him, it will be sufficient to have made the tender, and to preserve such record as will establish the fact that it was made. The records, in all cases, must be dated and timed, and must be made, plainly written, immediately after the tender of the message. It should rehearse all facts which may tend to keep his memory of the transaction complete.

It is desirable, though not essential, that on some of the occasions when the above-mentioned notice is delivered, as well as when the message is tendered, the observer should, if practicable, take with him another person, wholly disinterested, who may serve as an additional witness of the transaction.

Should the officer or employé in charge of the telegraph office inform the observer generally that he will not in future be admitted to the office at all, he will not, on that account, discontinue giving notice or making tenders, but will give and make, or attempt to give and make, them precisely as before.

AN ACT to aid in the construction of telegraph lines, and to secure to the Government the use of the same for postal, military, and other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That any telegraph company now organized, or which may hereafter be organized, under the laws of any State in this Union, shall have the right to construct, maintain, and operate lines of telegraph through and over any portion of the public domain of the United States, over and along any of the military or post roads of the United States which have been or may hereafter be declared such by act of Congress, and over, under, or across the navigable streams or waters of the United States: *Provided,* That such lines of telegraph shall be so constructed and maintained as not to obstruct the navigation of such streams and waters, or interfere with the ordinary travel on such military or post roads. And any of said companies shall have the right to take and use from such public lands the necessary stone, timber, and other materials for its posts, piers, stations, and other needful uses in the construction, maintenance, and operation of said lines of telegraph, and may pre-empt and use such portion of the unoccupied public lands subject to pre-emption through which its said lines of telegraph may be located as may be necessary for its stations, not exceeding forty acres for each station; but such stations shall not be within fifteen miles of each other.

SEC. 2. *And be it further enacted,* That telegraphic communications between the several departments of the Government of the United States and their officers and agents shall, in their transmission over the lines of any of said companies, have priority over all other business, and shall be sent at rates to be annually fixed by the Postmaster-General.

SEC. 3. *And be it further enacted,* That the rights and privileges hereby granted shall not be transferred by any company acting under this act to any other corporation, association, or person: *Provided, however,* That the United States may at any time after the expiration of five years from the date of the passage of this act, for postal, military, or other purposes, purchase all the telegraph lines, property, and effects of any or all of said companies at an appraised value, to be ascertained by five competent, disinterested persons, two of whom shall be selected by the Postmaster-General of the United States, two by the company interested, and one by the four so previously selected.

SEC. 4. *And be it further enacted,* That before any telegraph company shall exercise any of the powers or privileges conferred by this act, such company shall file their written acceptance with the Postmaster-General of the restrictions and obligations required by this act.

Approved July 24, 1866.

[PUBLIC RESOLUTION—No. 9.]

JOINT RESOLUTION to authorize the Secretary of War to provide for taking meteorological observations at the military stations and other points in the interior of the continent, and for giving notice on the northern lakes and sea-board of the approach and force of storms.

Be it resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be, and he hereby is, authorized and required to provide for taking meteorological observations at the military stations in the interior of the continent, and at other points in the States and Territories of the United States, and for giving notice on the northern lakes and on the sea-coast, by magnetic telegraph and marine signals, of the approach and force of storms.

Approved February 9, 1870.

[General Orders No. 18.]

WAR DEPARTMENT,
OFFICE OF THE CHIEF SIGNAL-OFFICER,
Washington, D. C., July 3, 1872.

The following order of the Secretary of War, having been received by the Chief Signal Officer of the Army, is published for the information of all concerned:

"WAR DEPARTMENT,
"Washington City, June 27, 1872.

"The Chief Signal-Officer of the Army is hereby directed and ordered to carry into effect the special duties imposed upon the Secretary of War by the act of Congress approved July 24, 1866, entitled 'An act to aid in the construction of telegraph lines and to secure to the Government the use of the same for postal, military, and other purposes,' and by the public resolution No. 9, approved February 9, 1870, and entitled 'Joint Resolution to authorize the Secretary of War to provide for taking meteorological observations at the military stations and other points in the interior of the continent, and for giving notice on the northern lakes and sea-board of the approach and force of storms,' and by the act approved June 10, 1872, entitled 'An act making appropriations for sundry civil expenses of the Government for the fiscal year ending June 30, 1873, and for other purposes;' and the said Chief Signal-Officer of the Army, and all such persons as have been or shall be designated and employed by him for the taking of meteorological observations, or for preparing or presenting telegraphic communications for transmission, or for transmitting the same, are hereby recognized and appointed as agents of the War Department, for those purposes, and are hereby authorized and directed by and in behalf of said Department to offer to any telegraph company in the United States, for transmission, any and all such telegraph communications as they may be required by the Chief Signal-Officer to make, and to request the transmission thereof by such company or companies, at such times, and in such places, as may be directed by said officer.

"WM. W. BELKNAP,
"Secretary of War."

By order of the Chief Signal-Officer of the Army :

GARRICK MALLERY,
Capt. and Brevet Lieut. Col., U. S. A.,
Acting Signal-Officer and Assistant.

AN ACT making appropriations for sundry civil expenses of the Government for the fiscal year ending June thirtieth, eighteen hundred and seventy-three, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated for the objects hereinafter expressed, for the fiscal year ending June thirtieth, eighteen hundred and seventy-three, viz:

UNDER THE WAR DEPARTMENT.

SIGNAL-OFFICE.

For manufacture, purchase, or repair of meteorological and other necessary instruments: for telegraphing reports; for expenses of storm-signals announcing probable approach and force of storms throughout the United States, for the benefit of commerce and agriculture; for instrument-shelters; for hire, furniture, and expenses of offices maintained for public use in cities or posts receiving reports; for maps and bulletins, to be displayed in chambers of commerce and boards of trade rooms; for books and stationery; and for incidental expenses not otherwise provided for, two hundred and fifty thousand dollars: *Provided*, That the Secretary of War be, and he hereby is, authorized and required to provide, in the system of observations and reports in charge of the Chief Signal-Officer of the Army, for such stations, reports, and signals as may be found necessary for the benefit of agriculture and commercial interests: *And provided*, That no part of this appropriation, nor of any appropriation for the several Departments of the Government, shall be paid to any telegraphic company which shall neglect or refuse to transmit telegraphic communications, between said Departments, their officers, agents, or employes, under the provisions of the second section of chapter two hundred and thirty of the statutes of the United States for the year eighteen hundred and sixty-six, and at rates of compensation therefor to be established by the Postmaster-General: *Provided also*, That whenever any telegraphic company shall have filed its written acceptance with the Postmaster-General, of the restrictions and obligations required by the act approved July twenty-fourth, eighteen hundred and sixty-six, entitled "An act to aid the construction of telegraph lines, and to secure to the Government the use of the same for postal, military, and other purposes," if such company, its agents or employes shall hereafter refuse or neglect to transmit any such telegraphic communications as are provided for by the aforesaid act, or by the joint resolution approved the ninth day of February, eighteen hundred and seventy, "To authorize the Secretary of War to provide for taking meteorological observations at the military stations and other points of the interior of the continent, and for giving notice on the northern lakes and sea-board of the approach and force of storms," such telegraphic company shall forfeit and pay to the United

States not less than one hundred and not exceeding one thousand dollars for each refusal or neglect aforesaid, to be recovered by an action or actions at law, in any district court of the United States.

Approved June 10, 1872.

NOTE.—In preparing these instructions free use has been made of the Smithsonian "Directions for Meteorological Observers," of those issued by the Surgeon-General of the Army, and of Colonel Williamson's valuable work on the barometer.

PAPER C.

CIPHER USED FOR THE TELEGRAPHIC TRANSMISSION OF THE WEATHER-REPORTS OF THE SIGNAL SERVICE, UNITED STATES ARMY, PREPARED UNDER THE DIRECTION OF THE CHIEF SIGNAL-OFFICER OF THE ARMY.

INSTRUCTIONS.

Each regular report will consist of ten words arranged in two lines of *five* words each.

At all stations designated by this Office as *river* stations, the *afternoon* report will consist of twelve words arranged in two lines of *six* words each, the last word in first line being river, and the last word in second line indicating the change in past twenty-four hours.

In filling up the form of report for telegraphic transmission, the first space of first line will be used for *name of station*, the second for *date* and *time* of report, the third for barometer, the fourth for thermometer, and the fifth for the humidity.

In the second line the first space will be used for state of weather, the second for velocity of wind, third for upper clouds, the fourth for lower clouds, and the fifth for the rain-fall.

The cipher words must in all cases be written plainly and correctly. The word *blank* will be used in all cases when no observation is taken.

EXAMPLE.

REGULAR REPORT.

Mount.	Cake.	Florid.	Throng.	Beast.
Caspian.	Relic.	Hidden.	Three.	Abase.

TRANSLATION.

Station.....	Mount Washington.	Weather	Cloudy.
Date.....	2d.	Direction of wind.....	Northwest.
Time	Morning report.	Velocity of wind.....	47 miles.
Barometer.....	30.07.	Upper cloud.....	Hidden.
Thermometer	19°.	Lower cloud.....	Foggy.
Humidity .....	.35.	Rain-fall .....	.01.

EXAMPLE.

RIVER REPORT.

Orleans.	Gay.	Folks.	Trial.	By.	River.
Burns.	Ranche.	Hidden.	Ten.	Append.	Hang.

TRANSLATION.

Station.....	New Orleans.	Direction of wind.....	Southeast.
Date	12th.	Velocity of wind.....	8 miles.
Time	Afternoon report.	Upper cloud.....	Hidden.
Barometer	30.19.	Lower cloud.....	Sky covered.
Thermometer	74°.	Rain-fall.....	.88.
Humidity	100.	River	9' inches rise.
Weather.....	Heavy rain.		

LIST OF STATIONS.

TELEGRAPHIC DESIGNATION.

All additional stations will be designated by their proper names unless otherwise ordered.

Albany.	Indianola.	Oswego.
Augusta.	Jacksonville.	Paul, (Saint Paul.)
Baltimore.	Keokuk.	Pembina.
Benton, (Fort Benton.)	Keys, (Key West.)	Philadelphia.
Boston.	Kingston.	Pittsburgh.
Buffalo.	Knoxville.	Portland.
Burlington.	Lake, (Lake City.)	Rassa, (Punta Rassa.)
Cairo.	Leavenworth.	Rochester.
Charleston.	London, (New London.)	Saint, (Saint Louis.)
Cheyenne.	Louisville.	Santa, (Santa Fé.)
Chicago.	Lynchburgh.	Sauguen.
Cincinnati.	Marks, (Saint Marks, Fla.)	Savannah.
Cleveland.	Marquette.	Shreveport.
Corinne.	May, (Cape May.)	Stanley, (Pt. Stanley, Ont.)
Davenport.	Memphis.	Sully, (Ft. Sully, Dakota.)
Denver.	Milwaukee.	Toledo.
Detroit.	Mobile.	Toronto.
Diego, (San Diego, Cal.)	Montgomery.	Vicksburg.
Dover, (Port Dover, Ont.)	Montreal.	Virginia, (Virginia City,
Du Luth.	Mount, (Mt. Washington.)	Mont.)
Escanaba.	Nashville.	Washington.
Francisco, (San Francisco.)	Norfolk.	Wilmington.
Galveston.	Omaha.	York, (New York.)
Haven, (Grand Haven.)	Oregon, (Portland, Oregon.)	
Indianapolis.	Orleans, (New Orleans.)	

DAY OF MONTH AND TIME OF OBSERVATION.

Day.	A. M. report.	P. M. report.	Midnight report.
1	Cad	Gab	Nag.
2	Cake	Gage	Nail.
3	Calf	Gain	Nash.
4	Cam	Game	Nave.
5	Camp	Gang	Navy.
6	Cane	Gap	Nay.
7	Cape	Gard	Neal.
8	Cary	Gas	Neap.
9	Case	Gate	Near.
10	Cash	Gaul	Neck.
11	Cat	Gave	Ned.
12	Chew	Gay	Nero.
13	City	Gem	Nest.
14	Clip	Get	New.
15	Coal	Gift	Next.
16	Cob	Gild	Nice.
17	Coke	Gin	Nick.
18	Cold	Gird	Nigh.
19	Come	Give	Nile.

DAY OF MONTH AND TIME OF OBSERVATION.—Continued.

Day.	A. M. report.	P. M. report.	Midnight report.
20	Copy	Glad	Nip.
21	Cork	Glen	Nod.
22	Cost	Go	Nook.
23	Cox	Gone	Noon.
24	Crab	Good	Nor.
25	Crow	Gray	Nose.
26	Cry	Grin	Not.
27	Cuba	Grub	Noon.
28	Cud	Gulf	Now.
29	Cuff	Gun	Nude.
30	Cup	Gust	Nut.
31	Cur	Guy	Nye.

The following words will be used to indicate the date and time of observations of 9 o'clock reports, when ordered from any station :

1 Mace	6 Malt	11 Mean	16 Mine	21 Mope	26 Mown
2 Made	7 Man	12 Meek	17 Minx	22 Morn	27 Mud
3 Magi	8 Mark	13 Meg	18 Moat	23 Moss	28 Muff
4 Main	9 Max	14 Mend	19 Mob	24 Moth	29 Mugs
5 Make	10 Maze	15 Met	20 Mood	25 Move	30 Musk
					31 Myth

Observers must write all cipher words clearly and distinctly.

BAROMETER.

28.25 to 28.99.

28.25 Faber.	28.44 Fagin.	28.63 Falstaff.	28.82 Farce.
28.26 Fabian.	28.45 Fagot.	28.64 Falter.	28.83 Fardel.
28.27 Fable.	28.46 Failure.	28.65 Familiar.	28.84 Farewell.
28.28 Fabric.	28.47 Fain.	28.66 Family.	28.85 Farina.
28.29 Fabulous.	28.48 Fairfax.	28.67 Famine.	28.86 Farley.
28.30 Facade.	28.49 Fairly.	28.68 Famish.	28.87 Farm.
28.31 Face.	28.50 Fairness.	28.69 Famous.	28.88 Faro.
28.32 Facial.	28.51 Fairy.	28.70 Fanatic.	28.89 Farrago.
28.33 Facile.	28.52 Faith.	28.71 Fanchon.	28.90 Farrand.
28.34 Facing.	28.53 Faithful.	28.72 Fanciful.	28.91 Farrier.
28.35 Faction.	28.54 Faithless.	28.73 Fancy.	28.92 Farrow.
28.36 Factor.	28.55 Falchion.	28.74 Fandango.	28.93 Fascine.
28.37 Factory.	28.56 Falcon.	28.75 Fane.	28.94 Fashion.
28.38 Factum.	28.57 Fallacy.	28.76 Fang.	28.95 Fast.
28.39 Faculty.	28.58 Fallen.	28.77 Fanning.	28.96 Fasten.
28.40 Fade.	28.59 Fallible.	28.78 Fantail.	28.97 Fastness.
28.41 Fading.	28.60 Fallow.	28.79 Fantasm.	28.98 Fatal.
28.42 Fady.	28.61 False.	28.80 Fantastic.	28.99 Fate.
28.43 Fagend.	28.62 Falsify.	28.81 Far.	

Corrected for temperature and elevation. All cipher words must be written clearly and distinctly. The word *blank* will be used when no observation is taken.

BAROMETER.

29.00 to 29.99.

29.00 Fatalism.	29.07 Faugh.	29.14 Fayal.	29.21 Feature.
29.01 Fated.	29.08 Fault.	29.15 Fayette.	29.22 Febrile.
29.02 Father.	29.09 Fauna.	29.16 Faxon	29.23 Federal.
29.03 Fathom.	29.10 Faust.	29.17 Fear.	29.24 Feeble.
29.04 Fatigue.	29.11 Favor.	29.18 Fearing.	29.25 Feed.
29.05 Fatling.	29.12 Fawn.	29.19 Feast.	29.26 Feeling.
29.06 Faucet.	29.13 Fay.	29.20 Feather.	29.27 Feline.

BAROMETER.—Continued.

28.99 to 30.99.

29.28 Felix.	29.46 Festus.	29.64 Figaro.	29.82 Finis.
29.29 Felon.	29.47 Fete.	29.65 Fight.	29.83 Finish.
29.30 Felony.	29.48 Fetid.	29.66 Figment.	29.84 Finland.
29.31 Female.	29.49 Feudal.	29.67 Figure.	29.85 Fire.
29.32 Fence.	29.50 Fever.	29.68 Filbert.	29.86 Firkin.
29.33 Fenian.	29.51 Few.	29.69 Filch.	29.87 Fiscal.
29.34 Fennel.	29.52 Fiance.	29.70 File.	29.88 Fish.
29.35 Fenton.	29.53 Fiasco.	29.71 Filed.	29.89 Fit.
29.36 Ferment.	29.54 Fibrin.	29.72 Filial.	29.90 Fitful.
29.37 Fern.	29.55 Fickle.	29.73 Fillet.	29.91 Fixed.
29.38 Ferret.	29.56 Fiddle.	29.74 Film.	29.92 Flag.
29.39 Ferrule.	29.57 Fidget.	29.75 Final.	29.93 Flagon.
29.40 Ferrum.	29.58 Fidus.	29.76 Finance.	29.94 Flail.
29.41 Ferry.	29.59 Field.	29.77 Finch.	29.95 Flake.
29.42 Fertile.	29.60 Fiend.	29.78 Find.	29.96 Flap.
29.43 Festa.	29.61 Fife.	29.79 Finder.	29.97 Flat.
29.44 Fester.	29.62 Fifteen.	29.80 Finely.	29.98 Flax.
29.45 Festive.	29.63 Fifth.	29.81 Finger.	29.99 Fled.

Corrected for temperature and elevation. All cipher words must be written clearly and distinctly. The word *blank* will be used when no observation is taken.

BAROMETER.

30.00 to 30.99.

30.00 Fledge.	30.25 Forest.	30.50 Frigid.	30.75 Fumid.
30.01 Fleet.	30.26 Forfeit.	30.51 Frill.	30.76 Fun.
30.02 Flesh.	30.27 Forge.	30.52 Fringe.	30.77 Function.
30.03 Flinch.	30.28 Forget.	30.53 Frisk.	30.78 Fuddling.
30.04 Fling.	30.29 Forgive.	30.54 Frit.	30.79 Fundless.
30.05 Flint.	30.30 Formal.	30.55 Frog.	30.80 Funeral.
30.06 Flock.	30.31 Formed.	30.56 Frolic.	30.81 Fungus.
30.07 Florid.	30.32 Forth.	30.57 Front.	30.82 Funk.
30.08 Floss.	30.33 Fortune.	30.58 Froth.	30.83 Furbish.
30.09 Flown.	30.34 Forum.	30.59 Frown.	30.84 Furious.
30.10 Flue.	30.35 Forward.	30.60 Frozen.	30.85 Furlong.
30.11 Fluid.	30.36 France.	30.61 Frugal.	30.86 Furnace.
30.12 Flurry.	30.37 Fraud.	30.62 Fudge.	30.87 Furnish.
30.13 Flute.	30.38 Fraser.	30.63 Fuel.	30.88 Furor.
30.14 Foal.	30.39 Freak.	30.64 Fugitive.	30.89 Further.
30.15 Focal.	30.40 Fred.	30.65 Fugue.	30.90 Furtive.
30.16 Focus.	30.41 Freely.	30.66 Fulcrum.	30.91 Fury.
30.17 Foist.	30.42 Freeman.	30.67 Fulfill.	30.92 Furze.
30.18 Folio.	30.43 French.	30.68 Fuller.	30.93 Furzy.
30.19 Folks.	30.44 Frenzy.	30.69 Fully.	30.94 Fusil.
30.20 Fondle.	30.45 Fresco.	30.70 Fullness.	30.95 Fusion.
30.21 Food.	30.46 Friar.	30.71 Fulsome.	30.96 Fuss.
30.22 Forage.	30.47 Friday.	30.72 Fulton.	30.97 Fustian.
30.23 Foray.	30.48 Friend.	30.73 Fumage.	30.98 Futile.
30.24 Forbid.	30.49 Frigate.	30.74 Fumble.	30.99 Future.

Corrected for temperature and elevation. All cipher words must be written clearly and distinctly. The word *blank* will be used when no observation is taken.

THERMOMETER.

—50° to —1°.

—50 Tabby.	—40 Tamp.	—30 Tariff.	—20 Tease.	—10 Tendril.
—49 Tablet.	—39 Tampico.	—29 Tarsus.	—19 Tedious.	—9 Tenor.
—48 Taboo.	—38 Tangent.	—28 Tartar.	—18 Teeth.	—8 Tenting.
—47 Tackle.	—37 Tangle.	—27 Taste.	—17 Telegram.	—7 Tenure.
—46 Tactic.	—36 Tannic.	—26 Taunt.	—16 Tell.	—6 Term.
—45 Take.	—35 Tansy.	—25 Tavern.	—15 Temper.	—5 Terror.
—44 Talbot.	—34 Tape.	—24 Tawny.	—14 Tempest.	—4 Test.
—43 Talent.	—33 Taper.	—23 Tax.	—13 Temple.	—3 Texas.
—42 Talmud.	—32 Tardy.	—22 Teach.	—12 Tenant.	—2 Text.
—41 Talon.	—31 Target.	—21 Teak.	—11 Tender.	—1 Thaler.

All cipher words must be written clearly and distinctly. The word *blank* will be used when no observation is taken.

THERMOMETER.

0° to 100°.

0 Than.	26 Tiff.	51 Total.	76 Tribune.
1 That.	27 Tiger.	52 Touch.	77 Trick.
2 Thebes.	28 Time.	53 Toulon.	78 Trifle.
3 Thee.	29 Tindall.	54 Towel.	79 Trill.
4 Theft.	30 Ting.	55 Town.	80 Trip.
5 Thence.	31 Tinker.	56 Trace.	81 Triplet.
6 There.	32 Tinsel.	57 Trade.	82 Tripod.
7 Thermo.	33 Tioga.	58 Traduce.	83 Trophy.
8 Thesis.	34 Tip.	59 Traffic.	84 Truant.
9 They.	35 Tipton.	60 Tragic.	85 True.
10 Thibet.	36 Titan.	61 Trail.	86 Truly.
11 Thick.	37 Tivoli.	62 Traitor.	87 Trump.
12 Thief.	38 Toddy.	63 Tram.	88 Trust.
13 Think.	39 Toga.	64 Transit.	89 Truth.
14 Thomas.	40 Toil.	65 Trash.	90 Tube.
15 Thou.	41 Token.	66 Travel.	91 Tuesday.
16 Thrash.	42 Told.	67 Tray.	92 Tuft.
17 Throat.	43 Tomb.	68 Treat.	93 Tug.
18 Throb.	44 Tone.	69 Treble.	94 Tumor.
19 Throng.	45 Tonic.	70 Tree.	95 Tump.
20 Throw.	46 Topaz.	71 Trend.	96 Tunis.
21 Thrum.	47 Topeka.	72 Trepan.	97 Tunnel.
22 Thyme.	48 Topic.	73 Trepid.	98 Turban.
23 Tick.	49 Torpid.	74 Trial.	99 Turbid.
24 Tide.	50 Tory.	75 Tribe.	100 Turf.
25 Tidy.			

All cipher words must be written clearly and distinctly. The word *blank* will be used when no observation is taken.

THERMOMETER.

101° to 125°.

101 Turgid.	108 Tutor.	114 Twixt.	120 Typic.
102 Turkey.	109 Twain.	115 Tybee.	121 Tyrant.
103 Turn.	110 Twenty.	116 Tycoon.	122 Tyrian.
104 Turner.	111 Twig.	117 Tyler.	123 Tyro.
105 Turtle.	112 Twirl.	118 Tymbal.	124 Tyrol.
106 Tuscan.	113 Twist.	119 Type.	125 Tyson.
107 Tusk.			

All cipher words must be written clearly and distinctly. The word *blank* will be used when no observation is taken.

RELATIVE HUMIDITY.

0 to 100 per cent.

0 Babel.	21 Balm.	41 Belle.	61 Blush.	81 Brew.
1 Baden.	22 Bane.	42 Bench.	62 Body.	82 Brick.
2 Bagnio.	23 Bard.	43 Bengal.	63 Bold.	83 Bride.
3 Bailiff.	24 Barge.	44 Benzine.	64 Book.	84 Brief.
4 Balance.	25 Barn.	45 Berth.	65 Botch.	85 Brim.
5 Balcony.	26 Bask.	46 Betel.	66 Both.	86 Bring.
6 Balize.	27 Baste.	47 Bevy.	67 Bow.	87 Brown.
7 Ballad.	28 Bathe.	48 Bilge.	68 Bowl.	88 Brunt.
8 Balsam.	29 Bay.	49 Bind.	69 Box.	89 Brute.
9 Bamboo.	30 Beadle.	50 Bite.	70 Boyle.	90 Buchu.
10 Bandit.	31 Beak.	51 Blame.	71 Brace.	91 Bud.
11 Banish.	32 Beale.	52 Bled.	72 Brad.	92 Budge.
12 Banjo.	33 Bean.	53 Bless.	73 Brain.	93 Buff.
13 Barley.	34 Beard.	54 Blew.	74 Brake.	94 Build.
14 Barran.	35 Beast.	55 Blight.	75 Bran.	95 Bulb.
15 Basil.	36 Beat.	56 Blithe.	76 Brash.	96 Bur.
16 Basket.	37 Beatty.	57 Bloom.	77 Brave.	97 Burg.
17 Bauble.	38 Beck.	58 Blot.	78 Bray.	98 Burst.
18 Baby.	39 Belch.	59 Blown.	79 Bread.	99 Busy.
19 Bade.	40 Belfast.	60 Blurt.	80 Breathe.	100 By.
20 Bail.				

All cipher words must be written clearly and distinctly. The word *blank* will be used when no observation is taken.

STATE OF WEATHER AND DIRECTION OF WIND.

Wind blowing from the—									
	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Calm.
Clear	Agnes.	Eliza.	Mabel.	Adam.	Cowper.	China.	Danube.	Aral.	Beech.
Foggy	Alice.	Fanny.	Mary.	Allen.	David.	Dublin.	Hudson.	Azof.	Cedar.
Fair	Amy.	Flora.	Mary.	Andrew.	Dickens.	Geneva.	Huron.	Baltic.	Cherry.
Cloudy	Anna.	Grace.	Maud.	Bacon.	Grant.	Italy.	Jordan.	Caspian.	Elm.
Clearing up	Betsey.	Helen.	Nellie.	Ben.	Green.	Japan.	Mohawk.	Cono.	Hemlock.
Threatening storm	Carrie.	Ida.	Olive.	Bryant.	Holmes.	Malta.	Niagara.	Garda.	Maple.
Light rain	Chloe.	Isabel.	Rachel.	Burke.	Homer.	Milan.	Ohio.	Java.	Oak.
Heavy rain	Clara.	Jane.	Rhoda.	Burns.	John.	Moscow.	Potomac.	Lomond.	Palm.
Light snow	Delia.	Josie.	Sarah.	Byron.	Mack.	Nantes.	Tagus.	Simcoe.	Pine.
Heavy snow	Dinah.	Judith.	Sophia.	Charles.	Ross.	Naples.	Volga.	Wener.	Spruce.
Hail or sleet	Edith.	Julia.	Susan.	Clark.	Sabine.	Paris.	Wabash.	Yellow.	Walnut.

All cipher words must be written clearly and distinctly.

VELOCITY AND PRESSURE OF WIND.

Velocity in one hour, miles.	Signal-service cipher.		Pressure on one square foot, pounds.	Designation of wind.	Velocity in one hour, miles.	Signal-service cipher.		Pressure on one square foot, pounds.	Designation of wind.
	Wind blowing steadily.	Wind variable.				Wind blowing steadily.	Wind variable.		
0	Race	Race	0	Calm.	72	Retake	Dram	25.92	Storm.
1	Rack	Daisy	0.01	Light.	73	Reveal	Drastic	26.64	Do.
2	Raft	Dale	0.02	Do.	74	Revenge	Dream	27.38	Do.
3	Rage	Daly	0.04	Gentle.	75	Review	Dread	28.12	Do.
4	Raid	Damp	0.08	Do.	76	Reville	Dress	28.88	Do.
5	Rake	Dan	0.12	Do.	77	Revoke	Drip	29.64	Do.
6	Rally	Dance	0.16	Fresh.	78	Rhyme	Drug	30.42	Do.
7	Ralph	Dark	0.24	Do.	79	Riddle	Druid	31.20	Do.
8	Ranche	Data	0.32	Do.	80	Ride	Drunk	32.00	Hurricane.
9	Range	Daub	0.40	Do.	81	Ridge	Dub	32.80	Do.
10	Rank	Deacon	0.50	Do.	82	Ridley	Ducal	33.62	Do.
11	Rapid	Deadly	0.60	Do.	83	Rife	Duce	34.44	Do.
12	Rare	Deaf	0.72	Do.	84	Rifle	Ductile	35.28	Do.
13	Rasp	Deal	0.84	Do.	85	Riga	Due	36.12	Do.
14	Rat	Death	0.96	Do.	86	Riggs	Duello	36.98	Do.
15	Ratio	Decay	1.12	Brisk.	87	Right	Duenna	37.84	Do.
16	Ravel	Deceit	1.28	Do.	88	Rigid	Duke	38.72	Do.
17	Raven	Decide	1.44	Do.	89	Rigor	Dulcet	39.60	Do.
18	Reach	Decry	1.62	Do.	90	Riley	Dungeon	40.50	Do.
19	Read	Debar	1.80	Do.	91	Rill	Dunlap	41.40	Do.
20	Ready	Debris	2.00	Do.	92	Ripe	Dupe	42.32	Do.
21	Rebate	Debt	2.20	Do.	93	Risk	Duplex	43.24	Do.
22	Rebel	Deem	2.42	Do.	94	Roam	During	44.18	Do.
23	Rebuff	Deep	2.64	Do.	95	Roar	Dusty	45.12	Do.
24	Rebuke	Deface	2.88	Do.	96	Roast	Dutch	46.08	Do.
25	Rebut	Defeat	3.12	Do.	97	Robber	Dyke	47.04	Do.
26	Redan	Defy	3.36	Do.	98	Robe	Dwarf	48.02	Do.
27	Redden	Demand	3.64	Do.	99	Robin	Dwindle	49.00	Do.
28	Rodeem	Demur	3.92	Do.	100	Robust	Dying	50.00	Do.
29	Reduce	Depart	4.20	Do.	101	Rocket		51.00	Do.
30	Reef	Deploy	4.50	High.	102	Rocky		52.02	Do.
31	Refer	Depot	4.80	Do.	103	Rodent		53.04	Do.
32	Refit	Depth	5.12	Do.	104	Rogue		54.08	Do.
33	Reflect	Derby	5.44	Do.	105	Roland		55.12	Do.
34	Reflex	Design	5.78	Do.	106	Rollo		56.18	Do.
35	Reform	Devil	6.12	Do.	107	Roman		57.24	Do.
36	Refuge	Devote	6.48	Do.	108	Rome		58.32	Do.
37	Refund	Dexter	6.84	Do.	109	Romish		59.40	Do.
38	Regain	Dial	7.22	Do.	110	Romp		60.50	Do.
39	Regal	Diana	7.60	Do.	111	Rosin		61.60	Do.
40	Regard	Diary	8.00	Gale.	112	Rosy		62.72	Do.
41	Regent	Did	8.40	Do.	113	Rough		63.84	Do.
42	Regret	Die	8.82	Do.	114	Round		64.98	Do.
43	Relate	Differ	9.24	Do.	115	Rout		66.12	Do.
44	Relax	Digest	9.68	Do.	116	Royal		67.28	Do.
45	Relay	Digit	10.12	Do.	117	Rubbish		68.44	Do.
46	Relent	Dimple	10.58	Do.	118	Rubrick		69.62	Do.
47	Relic	Dip	11.04	Do.	119	Ruby		70.80	Do.
48	Relish	Direct	1.52	Do.	120	Rudder		72.00	Do.
49	Remain	Dirge	12.00	Do.	121	Ruddy		73.20	Do.
50	Remark	Dish	12.50	Do.	122	Rude		74.42	Do.
51	Remit	Dismal	13.00	Do.	123	Rudely		75.64	Do.
52	Remote	Dismay	13.52	Do.	124	Ruffle		76.88	Do.
53	Renew	Dispose	14.04	Do.	125	Rugby		78.12	Do.
54	Repay	Ditto	14.58	Do.	126	Rugged		79.38	Do.
55	Repeat	Ditty	15.12	Do.	127	Ruler		80.64	Do.
56	Repine	Divan	15.68	Do.	128	Rum		81.92	Do.
57	Replant	Divide	16.24	Do.	129	Rumble		83.20	Do.
58	Report	Dixie	16.82	Do.	130	Ramford		84.50	Do.
59	Repose	Dodge	17.40	Do.	131	Rumney		85.80	Do.
60	Reps	Dome	18.00	Storm.	132	Rumpus		87.12	Do.
61	Reptile	Domino	18.60	Do.	133	Runlet		88.44	Do.
62	Rescue	Donkey	19.22	Do.	134	Running		89.78	Do.
63	Reship	Doric	19.84	Do.	135	Runyon		91.12	Do.
64	Reside	Doubt	20.48	Do.	136	Rupee		92.48	Do.
65	Resist	Dove	21.12	Do.	137	Ruption		93.84	Do.
66	Resolve	Dowdy	21.78	Do.	138	Rural		95.22	Do.
67	Respect	Dowell	22.44	Do.	139	Rush		96.60	Do.
68	Rest	Down	23.12	Do.	140	Rushes		98.00	Do.
69	Result	Dozen	23.80	Do.	141	Ruskin		99.40	Do.
70	Resume	Drab	24.50	Do.	142	Russell		100.82	Do.
71	Retain	Draft	25.20	Do.	143	Russia		102.24	Do.

VELOCITY AND PRESSURE OF WIND.

Velocity in one hour, miles.	Signal-service cipher.		Pressure on onesquare foot, pounds.	Designation of wind.	Velocity in one hour, miles.	Signal-service cipher.		Pressure on onesquare foot, pounds.	Designation of wind.
	Wind blowing steadily.	Wind variable.				Wind blowing steadily.	Wind variable.		
144	Rustic		103. 68	Hurricane.	148	Rutland		109 52	Hurricane.
145	Rustle		105. 12	Do.	149	Ryder		111 00	Do.
146	Ruth		106. 56	Do.	150	Ryland		112 50	Do.
147	Ruthless		108 04	Do.					

All cipher words must be written clearly and distinctly. The word *blank* will be used when no observation is taken.

AMOUNT, KIND, AND DIRECTION OF UPPER CLOUDS.

Clouds moving from the—									
N	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Calm.	
Clear.....	Ivy.	Catnip.	Bed.	Bonnet.	Cow.	Canary.	Brass.	Earth.	
Hazy	Jasmin.	Copal.	Carpet.	Boot.	Dog.	Eagle.	Carbon.	Mars.	
Clear to 1-4 cirrus	Lily.	Cubeb.	Chair.	Cravat.	Goat.	Grouse.	Cobalt.	Neptune.	
1-4 to 2-4 cirrus	Lotus.	Epsom.	Clock.	Glove.	Horse.	Magpie.	Copper.	Pallas.	
2-4 to 4-4 cirrus	Myrtle.	Ergot.	Desk.	Hat.	Lion.	Oatrich.	Iron.	Planet.	
Clear to 1-4 cumulus.....	Pansy.	Jalap.	Glass.	Pants.	Mule.	Petrel.	Mica.	Saturn.	
1-4 to 2-4 cumulus.....	Pink.	Madder.	Pan.	Shoe.	Nickel.	Pigeon.	Nickel.	Ursa.	
2-4 to 4-4 cumulus.....	Tulip.	Myrrh.	Stand.	Vest.	Wolf.	Quail.	Silver.	Venus.	
Upper clouds hidden	Will be indicated by the word <i>Hidden</i> .								

All cipher words must be written clearly and distinctly.

AMOUNT AND KIND OF LOWER CLOUDS.

Absence of lower cloud will be indicated by	One.
Atmosphere hazy will be indicated by	Two.
Atmosphere foggy will be indicated by	Three.
Atmosphere smoky will be indicated by	Four.
Sky clear to 1-4 covered with stratus clouds will be indicated by	Five.
Sky 1-4 to 2-4 covered with stratus clouds will be indicated by	Six.
Sky 2-4 to 4-4 covered with stratus clouds will be indicated by	Seven.
Sky clear to 1-4 covered with nimbus clouds will be indicated by	Eight.
Sky 1-4 to 2-4 covered with nimbus clouds will be indicated by	Nine.
Sky 2-4 to 4-4 covered with nimbus clouds will be indicated by	Ten.

All cipher words must be written clearly and distinctly.

RAIN-FALL SINCE LAST REPORT.

.00 to .49 inch.

.00 Ab.	.13 Acute.	.26 Afraid.	.38 Aid.
.01 Abase.	.14 Add.	.27 Aft.	.39 Ajar.
.02 Abbot.	.15 Aden.	.28 After.	.40 Akin.
.03 Abet.	.16 Adieu.	.29 Again.	.41 Alas.
.04 Abide.	.17 Adler.	.30 Agate.	.42 Alba.
.05 Able.	.18 Admit.	.31 Age.	.43 Album.
.06 Absent.	.19 Adorn.	.32 Aged.	.44 Alder.
.07 Abyss.	.20 Adri.	.33 Agent.	.45 Alert.
.08 Ache.	.21 Adrift.	.34 Agile.	.46 Alibi.
.09 Acid.	.22 Adult.	.35 Aglow.	.47 Alike.
.10 Act.	.23 Advise.	.36 Ague.	.48 Allay.
.11 Active.	.24 Afar.	.37 Ahead.	.49 Allege.
.12 Actor.	.25 Affix.		

.50 to .99 inch.

.50 Allude.	.63 Amber.	.76 Annex.	.88 Append.
.51 Alma.	.64 Amble.	.77 Annoy.	.89 Apply.
.52 Alms.	.65 Amen.	.78 Annul.	.90 April.
.53 Aloe.	.66 Amid.	.79 Anthem.	.91 Apron.
.54 Aloft.	.67 Amiss.	.80 Antic.	.92 Aqua.
.55 Along.	.68 Ammon.	.81 Auvil.	.93 Arab.
.56 Aloud.	.69 Ample.	.82 Any.	.94 Arcade
.57 Alpha.	.70 Anchor.	.83 Apart.	.95 Arch.
.58 Alps.	.71 And.	.84 Ape.	.96 Ardent.
.59 Also.	.72 Angel.	.85 Apex.	.97 Ardor.
.60 Alum.	.73 Angry.	.86 Apish.	.98 Argil.
.61 Am.	.74 Anise.	.87 Appeal.	.99 Argue
.62 Amaze.	.75 Ankle.		

1.00 to 1.49 inches.

1.00 Arm.	1.13 Asp.	1.26 Attune.	1.38 Avon.
1.01 Armor.	1.14 Aspen.	1.27 Auburn.	1.39 Await.
1.02 Arrow.	1.15 Asset.	1.28 Audit.	1.40 Awake.
1.03 Arson.	1.16 Assign.	1.29 August.	1.41 Aware.
1.04 Art.	1.17 Assist.	1.30 Austere.	1.42 Away.
1.05 Artist.	1.18 Assume.	1.31 Author.	1.43 Awe.
1.06 Artly.	1.19 Astral.	1.32 Autumn.	1.44 Awful.
1.07 Ascend.	1.20 Astray.	1.33 Avant.	1.45 Awhile.
1.08 Ashes.	1.21 Astute.	1.34 Avenge.	1.46 Ax.
1.09 Asia.	1.22 Atone.	1.35 Avenue.	1.47 Axis.
1.10 Aside.	1.23 Attend.	1.36 Averse.	1.48 Axle.
1.11 Ask.	1.24 Attire.	1.37 Avoid.	1.49 Azure.
1.12 Asleep.	1.25 Attract.		

1.50 to 1.99 inches.

1.50 Sago.	1.63 Scar.	1.76 Sense.	1.88 Shield.
1.51 Salary.	1.64 Scheme.	1.77 Serf.	1.89 Shift.
1.52 Sale.	1.65 Scorn.	1.78 Serge.	1.90 Shoal.
1.53 Salute.	1.66 Scot.	1.79 Serve.	1.91 Shock.
1.54 Sap.	1.67 Scrap.	1.80 Set.	1.92 Short.
1.55 Saul.	1.68 Scud.	1.81 Shake.	1.93 Shut.
1.56 Savor.	1.69 Sea.	1.82 Shape.	1.94 Sick.
1.57 Saw.	1.70 Seam.	1.83 Shave.	1.95 Sickly.
1.58 Saxon.	1.71 Season.	1.84 She.	1.96 Sidon.
1.59 Say.	1.72 Sedge.	1.85 Shed.	1.97 Sign.
1.60 Scab.	1.73 Seek.	1.86 Shelf.	1.98 Silex.
1.61 Scald.	1.74 Self.	1.87 Shell.	1.99 Silk.
1.62 Scape.	1.75 Send.		

All cipher words must be written clearly and distinctly. The word *blank* will be used when no observation is taken.

2.00 to 2.49 inches.

2.00 Silly.	2.13 Slight.	2.26 Snob.	2.38 Span.
2.01 Since.	2.14 Slow.	2.27 Snow.	2.39 Spank.
2.02 Size.	2.15 Slug.	2.28 Soap.	2.40 Spasm.
2.03 Skate.	2.16 Smack.	2.29 Soda.	2.41 Speck.
2.04 Skew.	2.17 Smash.	2.30 Sodom.	2.42 Spice.
2.05 Skid.	2.18 Smile.	2.31 Solar.	2.43 Spit.
2.06 Skiff.	2.19 Smoke.	2.32 Solid.	2.44 Spoil.
2.07 Skin.	2.20 Smut.	2.33 Soon.	2.45 Spoke.
2.08 Skip.	2.21 Snail.	2.34 Sort.	2.46 Sponge.
2.09 Sky.	2.22 Snake.	2.35 South.	2.47 Spree.
2.10 Sled.	2.23 Snap.	2.36 Sowing.	2.48 Sprig.
2.11 Slick.	2.24 Sniffle.	2.37 Spade.	2.49 Spring.
2.12 Slide.	2.25 Snipe.		

2.50 to 2.99 inches.

2.50 Spur.	2.63 Steam.	2.76 Strut.	2.88 Swan.
2.51 Spy.	2.64 Stem.	2.77 Stud.	2.89 Swap.
2.52 Stab.	2.65 Step.	2.78 Stuff.	2.90 Sway.
2.53 Stack.	2.66 Stern.	2.79 Stum.	2.91 Swede.
2.54 Stag.	2.67 Stew.	2.80 Style.	2.92 Swell.
2.55 Stain.	2.68 Still.	2.81 Suck.	2.93 Swift.
2.56 Stake.	2.69 Sting.	2.82 Suds.	2.94 Swim.
2.57 Stale.	2.70 Stock.	2.82 Suit.	2.95 Swiss.
2.58 Stall.	2.71 Stray.	2.84 Sum.	2.96 Sylph.
2.59 Star.	2.72 Strict.	2.85 Sunny.	2.97 Synod.
2.60 Stark.	2.73 Stride.	2.86 Surf.	2.98 Syntax.
2.61 Stay.	2.74 String.	2.87 Swag.	2.99 Syria.
2.62 Steal.	2.75 Stroke.		

All cipher words must be written clearly and distinctly. The word *blank* will be used when no observation is taken. Any fall of rain of 3 inches and over will be given in special dispatch.

RIVER REPORT.

Change in last twenty-four hours.

0 to 99 inches.

Rise.	Fall.	Rise.	Fall.
0 Habit.	Habit.	11 Harbor.	Lansing.
1 Hadley.	Labor.	12 Harden.	Lantern.
2 Hague.	Lackey.	13 Harem.	Lapse.
3 Hair.	Lad.	14 Harlot.	Larch.
4 Half.	Laden.	15 Harm.	Lard.
5 Halo.	Lady.	16 Harper.	Large.
6 Halter.	Lager.	17 Harry.	Lash.
7 Hamlet.	Lain.	18 Harsh.	Late.
8 Handy.	Lamb.	19 Harvest.	Lath.
9 Hang.	Land.	20 Haste.	Latin.
10 Happy.	Landing.	21 Hatch.	Latrobe.

Rise.	Fall.	Rise.	Fall.
22 Hawk.	Laugh.	61 Hoist.	Limit.
23 Hayti.	Laura.	62 Holly.	Limpid.
24 Hazard.	Laurel.	63 Holy.	Linen.
25 Hazel.	Lava.	64 Home.	Lingo.
26 Hazy.	Lavish.	65 Homely.	Lisbon.
27 Heal.	Law.	66 Honest.	List.
28 Heap.	Lawn.	67 Honey.	Listen.
29 Heart.	Lawyer.	68 Honor.	Litany.
30 Heath.	Lead.	69 Hood.	Lithia.
31 Heathen.	League.	70 Hoop.	Litmus.
32 Heavy.	Lean.	71 Horde.	Livid.
33 Hebe.	Leaping.	72 Horn.	Loaf.
34 Hebrew.	Learn.	73 Hornet.	Lobby.
35 Hebron.	Leaven.	74 Host.	Local.
36 Hector.	Lecture.	75 Hotel.	Locust.
37 Held.	Ledger.	76 Hound.	Lodi.
38 Helix.	Left.	77 Hour.	Logan.
39 Helm.	Leg.	78 Hovel.	Logic.
40 Helot.	Legal.	79 Hub.	Lonesome.
41 Help.	Legend.	80 Huff.	Loud.
42 Hence.	Leghorn.	81 Huge.	Louse.
43 Henry.	Lemon.	82 Human.	Love.
44 Herald.	Lenox.	83 Humbug.	Lover.
45 Herd.	Lentel.	84 Humid.	Loving.
46 Heresy.	Lesson.	85 Hump.	Loyal.
47 Hermit.	Level.	86 Hunch.	Lubeck.
48 Hernia.	Levity.	87 Hunger.	Lubin.
49 Heroic.	Levy.	88 Hunt.	Lucas.
50 Heron.	Lewd.	89 Hunter.	Luck.
51 Hew.	Lewis.	90 Hunting.	Lucy.
52 Hide.	Leyden.	91 Hurley.	Lumber.
53 High.	Libel.	92 Hush.	Luna.
54 Hinge.	Liberal.	93 Hybrid.	Lunatic.
55 Hinton.	Liberty.	94 Hydra.	Lundy.
56 Hire.	Libra.	95 Hydrant.	Luster.
57 Hoar.	Lichen.	96 Hymen.	Lute.
58 Hoax.	Life.	97 Hymn.	Lydia.
59 Hock.	Light.	98 Hyphen.	Lykens.
60 Hog.	Limbo.	99 Hypo.	Lyrix.

All cipher words must be written clearly and distinctly. The word *blank* will be used when no observation is taken.

RIVER REPORT.

Change in last twenty-four hours.

8 to 30 feet.

Rise.	Fall.	Rise.	Fall.
8 Oakum.	Wafer.	20 Only.	Whack.
9 Oath.	Waken.	21 Opal.	Wharf.
10 Obey.	Walk.	22 Oppress.	What.
11 Obtain.	Wander.	23 Optic.	Whig.
12 Odds.	Water.	24 Order.	Wick.
13 Odium.	Wave.	25 Organ.	Wild.
14 Offal.	Wax.	26 Other.	Wing.
15 Offend.	Weak.	27 Ought.	With.
16 Often.	Weigh.	28 Ounce.	World.
17 Ogre.	Well.	29 Owing.	Worse.
18 Omega.	Wench.	30 Oxford.	Worthy.
19 Omit.	Weston.		

The sixth space in first line of Form 5 will be used for the depth in feet whenever it exceeds eight feet, and the sixth space in second line for the odd inches.

Whenever the depth does not exceed eight feet, the word "River" will be used as at present to fill the space in first line, and the whole depth given in the second line in inches. The present cipher words will be used, but the head-line, "Change in last 24 hours," will be erased.

All cipher words must be written clearly and distinctly. The word *blank* will be used when no observation is taken.

PAPER D.

INSTRUCTIONS FOR THE MANAGEMENT OF THE SELF-RECORDING METEOROLOGICAL INSTRUMENTS AT THE OFFICE OF THE CHIEF SIGNAL-OFFICER OF THE ARMY, WASHINGTON, D. C.

INSTRUCTIONS.

Hough's printing barometer.

The paper on the cylinder to the right, and the strips on which the record is printed, are changed every day at noon.

The paper on the cylinder to the left is changed at 12 m., on the 1st and 15th of each month of 30 days, and on the 1st and 16th of each month of 31 days.

For the daily record:

1. Date the papers, across the end of the small strip and on top of the cylinder record.
2. Remove the old record from the cylinder (on the left) by drawing back the pencils from the cylinder, and holding them back by means of the small brass wire between them, and raising the spring-clamps.
3. Put on the new paper in the same position, letting the lower margin rest upon the shoulder on the cylinder, and replace the spring-clamps.
4. On the side of the clock is a small cylinder, around which is wound a cord which revolves the record cylinder. Revolve this small cylinder to the left, which will wind up the cord and move the record around to its proper position.
5. Allow the pencil to press against it again, by letting go the small brass wire which holds it. The pencil is adjusted to the proper horizontal line by the set-screws on the vertical shaft. (Adjust the pencil of the 15-day record in the same manner.)
6. At the time the small cylinder is revolved, (see 4,) the carriage on which the figures are printed is carried back to its starting position on the left; to remove the slip, loosen the set-screws in the middle and at each end, when the old record will drop out.
7. Lay the new strip down, place a small strip of clean paper, three-fourths of an inch wide, on the upper margin, and on top of this a piece of carbon paper the size of the record; then invert the carriage, and, holding the strips together, place them in the slots of the carriage, tighten the set-screws, let the carriage hang down, and slide it to the right, until one inch of it has passed the type, then fasten it to the cord with the set-screw.
8. If the types become misplaced they should be adjusted by revolving the type-wheels until the proper figures are in front; adjust the weight to the striking lever by moving it to the right or left, and the leather on the printing lever by the set-screws.
9. The batteries should be examined daily, and all points of contact kept clean.
10. Compare with standard barometer daily, and write the error (if any) on the back of the record, which should be carefully traced with black ink.
11. To change the 15-day record remove the paper by loosening the spring-clamps; place the new paper in the same position, with the lower margin resting upon the ledge on the cylinder, and fasten with the spring-clamps.
12. Take hold, with the left hand, of the toothed-wheel, around the vertical shaft of which is wound the cord which revolves the 15-day cylinder, at the same time draw the right end of the horizontal lever (which fits in an eccentric on the side of the clock and allows the toothed-wheel to move one tooth each hour) from the eccentric, and revolve the toothed-wheel until the record cylinder turns completely around, and let the pencil rest upon the proper time-line.
13. Wind the clock every day. The weight which drives the record portion of the instrument should be wound as often as it runs down, sometimes three or four times daily. Great care must be taken to prevent the weight from reaching the floor.

Hough's electric meteorograph

records barometer and wet and dry thermometers, the barometer being in the room and the thermometers in a louver-boarded box outside, and connected to the marking-lever by platinum wires. To change the record, (which should be done at noon on the 1st and 15th of each month)—

1. Remove the old record by drawing out the thumb-tacks.
2. Place the new record in the same position, resting the lower edge of it upon the flange on the cylinder, and replace the thumb-tacks to hold it.
3. Take hold of the toothed-wheel, on the axle of which is wound the cord which turns the cylinder, and with the right hand draw out the set-screw from the eccentric on the side of the clock, by lowering of which the toothed-wheel will be allowed to revolve, wind up the cord with this wheel until the record cylinder makes an entire revolution, let the recording point impinge upon the proper-time line, and fasten the cylinder by replacing the set-screw in the eccentric.

The instrument records three times each hour, once for the barometer and once for each

thermometer; the barometer recording as the lever is moving upward, and the thermometers recording as it moves downward.

4. The batteries should be inspected daily, and contact points kept clean.

5. Compare with standard barometer every time the record is changed, and note the difference (if any) on the back of the record. The barometer is adjusted by raising or lowering the contact point along the rod which moves by the side of the barometer. The thermometers are adjusted to any desired point, giving sufficient room for the variations of temperature.

Hough's electric barometer.

1. The record is changed at 12 m. on the 1st and 15th of each month. (If the month has 31 days change on the 16th.)

2. Take out the thumb-tack and remove the old record.

3. Place the new paper in position, resting the lower edge of it upon the flange on the cylinder, and replace the thumb-tack to hold it.

4. Take hold of the toothed-wheel, on the axle of which is wound the cord which turns the cylinder, and with the right hand draw back the horizontal lever from the eccentric on the side of the clock, which will allow the toothed-wheel to revolve, wind up the cord with this wheel until the record cylinder makes one complete revolution. See that the recording point impinges upon the proper-time line, and fasten the cylinder by replacing the horizontal lever upon the pin on the eccentric. The instrument should record once every hour.

5. Inspect the batteries daily and see that the contact points are kept clean.

6. Compare with standard barometer every time the record is changed and note the difference (if any) on the back of record. The barometer is adjusted by raising or lowering the nut, which carries the contact point, on the rod which moves vertically by the side of the barometer.

Peelor's barometer.

1. Date the paper, and change the record daily at 12 m.

2. See if the pointer is being driven into the paper; if so, wait until it is out; then remove the elastic bands from the ends of the cylinder, letting go the old record, which remove.

3. Place the new record on the cylinder, with the top of the paper to the right, and replace the elastic bands to fasten the paper.

4. Revolve the cylinder (which is held by a ratchet) in either direction, until the needle points to the proper hour on the paper.

The vertical rod holding the needle is balanced by the weights on the lower end of it. The barometer is adjusted by means of a set screw on top of the upper end of the box which holds the siphon barometer. The instrument should be compared with the standard every fifteen days, and the difference noted on the back of the record.

Wild's barometer

consists of a horizontal lever working on a knife-edge at its center, to the right end of which is suspended the barometer. The lower end of the barometer is suspended in a cistern of mercury. The barometer is balanced by a weight on the left end of lever, and by another lever projecting slightly from the perpendicular with another weight. Perpendicular to the first lever is a long arm carrying a point, which hangs before the paper, (the paper being carried vertically from one roller to another,) and which is driven into the paper once every ten minutes by the action of the magnets, the contact being made through the clock. The paper should be marked each day with the time and height of barometer as compared with the standard, and at the end of each month cut off and properly ruled.

Beck's "aneroid barometer."

1. Date the paper, and change the record every Monday at 12 m.

2. Remove the cylinder which holds the paper, by lifting it upward and to the left.

3. Remove the old record from the cylinder, by loosening the spring-clamps.

4. Put on the new paper so the lower edge of it rests upon the upper side of the lower spring-clamp.

5. Replace the cylinder so that the cogs on the lower margin of it will fit in the endless screw and the brass marker will point to the proper hour.

6. Adjust the marker to the proper height on the paper, by raising or lowering the barometer with the clock-key through the hole in the top of the case.

7. Wind the clock.

8. Compare with standard barometer every two weeks, and adjust the aneroid with the clock-key through the hole in the back of the case until the indicator points to the proper position.

Photographic barometer

consists of a slate slab on which is placed a dark chamber. In this dark chamber is a photograph lens and a cylinder on which is placed the prepared paper and which is revolved by clock-work once in forty-eight hours. The barometer is placed so that the upper end stands in front of a lighted lamp, the light being concentrated and thrown upon the photograph lens by a powerful condensing lens.

Photographic thermometers

consist of a dark chamber and lens, same as in the barometer. The thermometers (wet and dry) are long and the bulbs are outside the room, the upper ends standing before the photograph lens. The light is placed in front and reflected back by means of mirrors. The thermometers are adjusted to the proper height by means of a screw standing between them.

The records are changed in exactly the same manner both on barometer and thermometers, viz:

1. The ordinary photograph waxed paper is used as furnished.

2. Is bathed in a solution of potassium for three hours, of the following proportions:

Iodide potassium, grains	582.5
Bromide potassium, grains	417.5
Distilled water, ounces	40

3. It is then made sensitive by floating for ten minutes on a nitrate of silver solution—

Nitrate of silver, grains	300
Glacial acetic acid, drachms	2
Distilled water, ounces	20

4. Wash twice in distilled water and dry in a dark room, when it is ready to be placed on the cylinder in the photographic dark chamber.

5. Supposing a record to be already on, to remove it first darken the room, then raise the cover of dark chamber, lift off of the cylinder, and place in a dark box for the purpose of carrying it to the dark room.

6. Make a saturated solution of gallic acid in alcohol and dilute it two-thirds with water. Float the record on this solution until developed, then carefully wash.

7. Fix with hyposulphite of soda.

Gibbon's electric self-recording anemometer.

Near the top of the post on which the anemometer is fixed, place two screws "c" and "d," (Fig. 1;) to each of these screws fasten the wires separately, (the insulated wire to one, and the naked wire to the other,) leaving just sufficient of the upper end of each wire to reach to the outside ends of the contact bars "a" and "b," to which securely fasten with the binding screws—taking great care not to loosen the insulating attachment "g." Then pass the lower ends of the wire down the post, over the roof, and down the side of the house (securing so the wind will not sway them) to the top of the office window; pass them in through two small holes (where the sash and shutters will not injure them) and down the inside. In crossing the roof it is well to fasten them between two wooden strips, one on top of the other. One wire should then go to the screw cup "h," (Fig. II,) and the other to one pole of the battery at "i," then from the other pole "m" of the battery run a wire to the screw-cup "k," when the circuit is completed, and the armature will be closed once for each mile the wind travels.

Particular care must be taken that all of the connections are tight.

For putting on the paper:

Place the cylinder "s" on a table in front, with the screw "r" to the left hand; place the paper on the cylinder with the top of it from the screw. Let the line marked 12 m. (noon) come on the line marked on the cylinder, and place a small rubber band on each end. The lines on each end of the paper will then exactly coincide.

Place the cylinder "s" in its position, so that the end on which there is no screw "t" will be close up to the post on which it rests. Slide the small sliding-bar "n" on the horizontal bars "o, o," until it fits on the ends of the screw-axle "r;" then revolve the cylinder until the pencil will rest on the end of the upper line marked 12 m., and tighten the thumb-screw "n."

Much care must be taken in adjusting the armature spring, so that it will not be too strong for the magnet, and still strong enough to draw back the pencil in a straight line.

The mark for the record should be a little less than one-eighth of an inch long, and never more than this. This is arranged by moving the armature set-screw P, until the pencil points to the line marked 12 m. Then move the magnets, by means of the adjusting screw Q, until the mark is the proper length.

The pencils should be kept pointed enough to give a clear and distinct mark.

Use No. 3 pencils.

The clock should be wound every day, when the record is changed.

The record should be changed daily, at 12 o'clock, noon.

NOTE.—For the instructions referred to, see Instructions to Observer-Sergeants.

Gibbon's electrical anemometer and anemoscope

consists of the anemometer above described, for showing the velocity of wind, with the cylinder made two and one-half inches longer, on the right end of which is printed the direction of the wind once every five minutes. The magnets consist of four single coils placed in front of the cylinder and connected with the vane on roof of building by means of four wires. To the armatures which lay on the sides of the coils are attached levers, on the ends of which are types which print the direction of the wind once every five minutes, (on some of the instruments, on others the direction is given once in every mile the wind travels,) the contact being made through the clock. The paper for the record is changed exactly as on the anemometer before described, and the marking points and types adjusted to the proper position by means of the set-screw on the right, which moves all the magnets at once, all being fastened upon one plate.

Beck's anemometer.

1. Date the paper.
2. Raise the helices from the cylinder by means of the brass handle between them, loosen the cylinder shaft from the clock by means of the capstan-screw between the cylinders and clock.
3. Take off the old record by pressing the spring-clamps which hold the paper.
4. Place the new paper around the cylinder with the side marked "Direction" to the right, let the small point in the center of cylinder pierce the crossed lines; draw the other end tight and regular and fasten by spring-clamps.
5. Wind the clock.
6. Set the cylinder in its proper position by revolving it until the stylus between the helices points to 10 o'clock a. m., then fasten the cylinder by revolving the capstan-screw.
7. By means of the small brass lever press the helices down upon the paper.
8. The pressure of the helices is regulated by moving the small brass weights to or from them.
9. To adjust the direction helices, loosen the brass nut on the vertical rod, raise the piece to which is attached the ball and socket joint, and adjust the helix by revolving it, at the same time adjusting direction plate indicator on the lower end of the vertical rod, lower it again and make fast the brass nut.
10. The velocity is adjusted in the same manner. They both need adjusting *but one* unless disturbed.

Wild's anemometer, anemoscope, and rain-gauge

consists of an apparatus for measuring the direction and velocity of the wind and the amount of rain-fall, having a horizontal shaft to which is attached points carrying eight small friction-wheels, corresponding to the eight cardinal points of the compass; the wheel which corresponds to the point from which the wind is blowing is continually pressed against the paper by a cam upon a shaft revolved by a vane upon the roof of the building. On the same horizontal shaft is a slide to which is attached a point for recording the amount of rain-fall; the water being conducted from the gauge on the roof of the building to the water-wheel, which revolves, drawing the slide to the left; once every ten minutes the armature is attracted by the magnets, (the contact being made through the clock,) driving the point on the slide through the paper, at the same time letting go the spring which draws the slide, and the slide falls back to its original position, the distance from which, to the hole made, showing the number of liters of water fallen during the preceding ten minutes.

The velocity of wind is registered in precisely the same manner as the rain-fall, the marking point being drawn to the left by a vertical shaft connected to the Robinson hemispherical cups on the roof of the building; the distance from the fiducial line (marked by a fixed point) to the hole made, showing the number of miles the wind traveled in the preceding ten minutes.

The paper is drawn from one roller to another, and should be recorded and compared as on the hygrometer and thermometer.

Once each day the time and date should be marked on the paper opposite the record made at that moment.

Draper's anemoscope.

1. Date the paper, and change the record daily at noon.
2. Draw out the wire to which is fastened the rubber spring which drives the pencil; re-

move the cylinder, by raising with one hand the vertical shaft (outside the case) about one inch; then raise the cylinder and lift it clear of the lower socket, and by again lowering take it out.

3. Remove the old record, by raising the spring-clamp and sliding the paper off the lower end of the cylinder.

4. Place some paste along the back side of left margin of the new record paper; wrap it around the cylinder, and press the edges together closely.

5. Slide the paper up under the spring-clamp, until the left side of the clamp is in a line with the left margin of the paper at the point marked "North."

6. Raise the vertical shaft; place the cylinder in its proper position, and let the shaft down; then revolve the cylinder until the axle on top of it slips into the notch cut for it in the shaft.

7. Wind the clock, which will raise the weight with marking point to top of cylinder, and to the line marked 12 m.

8. Put in a piece of No. 2 lead one inch long, and replace the spring which presses it, taking care that the pencil points to the proper-time line on the paper.

Draper's anemometer for force of the wind.

1. Date the paper, and change the record at 12 m. daily.

2. Draw out the wire which drives the pencil; remove the old record by raising the spring-clamps which hold the paper to the carriage.

3. Place the new paper in the place from which the old one was removed, taking care to adjust it so the pencil will press directly upon the lower line on the right end of the paper.

4. Wind the clock, which will draw the carriage to the right, drawing until the pencil presses upon the intersecting lines marked 12 m. and the lower line of the paper.

5. Replace the wire which pushes the lead against the paper. Use No. 3 lead.

Draper's anemometer for velocity of the wind.

1. Date the paper, and change the record daily at 12 m.

2. Draw out the wire which pushes the lead against the paper; remove the old record, by raising the spring-clamps which hold it to the carriage.

3. Place the new paper in the place from which the old one was removed; let the lower edge of the paper rest upon the points in the carriage, (which should always be adjusted so the pencil when down will strike on the lower line.)

4. Wind the clock—which will draw the carriage to the right—until the pencil rests upon the proper vertical time line.

5. Replace the wire which pushes the lead against the paper. Use No. 2 lead.

Draper's rain-gauge.

1. Date the paper, and change the record daily at 12 m.

2. Hold the carriage back from the pencil, and remove the old record by raising the spring-clamps which hold it to the carriage.

3. If there has been rain since the noon previous, and water remaining in the suspended reservoir, remove it by means of a siphon.

4. Place the new paper in the same place, and let the pencil point to the upper line.

5. Wind the clock—which will draw the carriage to the right—until the pencil rests upon the upper horizontal line and the proper vertical time line.

6. Adjust the pencil to make a very light line, afterward to be traced with ink. The amount of water should be measured by the hand-gauge every two weeks, and the spring-balance adjusted by screwing it up or down.

Beckley's rain-gauge.

1. Date the paper, and change the record daily at 12 m.

2. Press the spring which holds the pencil back from the record, and lift off the cylinder with the old record on it.

3. Remove the old record by loosening the spring-clamps.

4. Place the new record on the cylinder with the lower edge resting on the lower spring-clamps.

5. Wind the clock by turning the cylinder shaft to the left. If any water remains empty it out by reversing the top portion of the reservoir.

6. Place the cylinder with new record on its shaft, letting the pencil-point rest upon the upper horizontal line and the proper-time line.

7. Start the clock by turning the large thumb-screw over the clock.

8. When rain has fallen trace the record with ink.

9. Adjust the pencil by means of the small set-screw over it.

PAPER F.

LIST OF THE GREAT STORMS, HURRICANES, AND TORNADOES OF THE UNITED STATES. PREPARED BY I. A. LAPHAM, ASSISTANT TO THE CHIEF SIGNAL-OFFICER, UNITED STATES ARMY.

- 1635, Aug. 15.—A violent storm or hurricane did much damage in New England.—(Dwight.)
- 1678.—A bark cast away on Lake Ontario in November—the first lake disaster.—(Hennepin.)
- 1679, Aug. 26.—The Griffin, the first sail-vessel on the upper lakes, encountered a severe gale on Lake Huron.—(Hennepin.)
- Sept.—The Griffin lost on one of the upper lakes.—(Hennepin.)
- Oct. 1, 4.—Voyagers driven ashore, on the west coast of Lake Michigan, by stress of weather.—(Hennepin.)
- 1692, March 4.—A furious storm of wind and rain at New Haven, Connecticut.—(Am. Jour. Sci., 42, p. 399.)
- March 13.—Another storm at New Haven.—(Ibid.)
- 1697, Oct. 18.—Hurricane in Maryland, Delaware, in Philadelphia, &c.—(Tr. Am. Phil. Soc., i, p. 350.)
- 1699.—A severe hurricane in South Carolina.—(Draper; Blodget, p. 397.)
- 1700, Sept. 16.—Storm at Charleston, South Carolina.—(Ramsay, Hist., 2, p. 314; Blodget, Clim., p. 397.)
- 1713, Sept. 16, 17.—Hurricane at Charleston, South Carolina.—(Ramsay, p. 314; Blodget, p. 397.)
- 1717, Feb. 18, 24 (O. S.)—Great snow-storm in New England.
- 1723.—A very destructive hurricane at New Orleans, Louisiana.—(Barton; Blodget, p. 397.)
- 1728, Sept. 14.—A great storm at Charleston, South Carolina.—(Hewat; Ramsay, p. 314; Blodget, p. 397.)
- 1751, March 12.—A violent tempest in New England.
- 1752.—Hurricane at Charleston, South Carolina, early in September.—(Chalmers's Weather of South Carolina; Blodget, p. 397.)
- Sept. 15.—The second hurricane in this month at Charleston, South Carolina.—(Prioleau; Chalmers; Ramsay, p. 314; Blodget, p. 397.)
- 1754, Oct. 24.—A great storm in New England, with heavy rains.—(Smith; Mass. Agr. Rep., 1854, p. 38.)
- 1756.—Saint Simon's Island, Georgia, flooded during a storm.—(Lyell, 2d Visit, 1, p. 253; Blodget, p. 397.)
- 1757, Oct.—A hurricane from West Florida, to Boston.—(Investigated by Benjamin Franklin; Volney's View, p. 196.)
- 1761, May 2.—A tornado at Charleston, South Carolina, at 2½ p. m.—(Am. Register; Piddington, p. 97.)
- 1769, Sept. 8.—A tempest in New England.
- 1770, Oct. 19.—A tempest in New England.
- 1771, Feb. 8.—A storm at Philadelphia, Pennsylvania, with very high tide.—(Tr. Am. Phil. Soc., 1, p. 179.)
- 1772, Aug. 31 to Sept. 3.—Hurricane in Louisiana.—(Guyarre; Blodget, p. 397.)
- 1773, Aug. 14.—A very destructive hurricane in Eastern Massachusetts.—(Tr. Am. Phil. Soc., 2, p. 137.)
- 1778, Aug. 18.—A violent tempest in New England.
- Oct. 7, 10.—Storm at New Orleans, Louisiana.—(Golver; Guyarre; Blodget, p. 397.)
- 1779, Aug. 18.—Hurricane at New Orleans.—(Dunbar in Tr. Am. Phil. Soc., 6, p. 53; Guyarre; Blodgett, p. 397.)
- Oct. 7, 10.—Storm in Lower Louisiana. Very high sea.—(Guyarre; Blodget, p. 397.)
- 1780, May 19.—Was known as the "dark day" in Northern States and Canada.—(Thompson's Vt., p. 16.)
- Aug. 24.—Storm in Louisiana.—Guyarre; Blodget, p. 397; Dunbar in Tr. Am. Phil. Soc., 6, p. 53.)
- Oct. 3, 5.—Hurricane in Jamaica. Cuba, Florida, &c.—(Redfield, Am. Jour., 31, p. 120, and ii, 2, p. 323; Blodget, p. 397.)
- 1783, Oct. 14.—A severe storm on Lake Erie.—(Tr. Am. Phil. Soc., 3, p. 63.)
- 1787, Aug. 15.—Five tornadoes in different States on this day.—(Butler; Atmos. Syst., p. 332.)
- 1794, June 19.—Tornado at Northford, Connecticut.—(Maltby in Am. Jour. Sci., 39, p. 384.)
- 1797, September.—Storm at Charleston, South Carolina.—(Drayton; Blodget, p. 397.)
- 1804, Aug. 19.—A violent tempest from the southwest in New England.
- Sept. 3, 9.—Storm at Charleston, 7th; Norfolk, 8th; Boston, 9th.—(Redfield, Am. Jour. 20, p. 42, and 31, p. 124; Chart, No. v; Ramsay; Drayton; Lyell; Blodget, p. 397; Piddington.)
- Oct. 9, 10.—Very extensive storm in New England.
- 1806, Sept. 19.—Tempest at South Hadley, Massachusetts.

- 1809, Jan.—Violent storm over great part of the country.—(Dewey in N. Y. Reg. Rep., 1849, p. 235.)
 May 28.—Tornado at Cincinnati, Ohio, &c.—(Drake: Blodget, p. 403; Butler, p. 310.)
 1810, Jan. 19.—Known as the "cold Friday" in the Northern States.
 1811, Feb. 2.—A great snow-storm in New England; continued three days.
 Sept. 10.—Hurricane on the Atlantic coast, called "the Cuba hurricane."—(Redfield, Am. J., ii, 2, p. 186; Piddington, p. 313; Niles's Register; Blodget, p. 398 and 403; Barton.)
 1812, Aug.—Hurricane at mouth of the Mississippi.—(Drake; Blodget, p. 398.)
 1813, July 15.—A tornado in New York.
 Aug. 27.—Hurricane at Charleston, South Carolina.—(Niles's Register; Blodget, p. 398.)
 1814, July 1.—Hurricane at Charleston, South Carolina.—(Niles's Register; Blodget, p. 398.)
 1815, Sept., 18, 24.—Hurricane in New England States.—(Farrar; Am. Phil. Trans.; Beck, Am. J., 1, p. 389; Darling, Am. J., 42, p. 243; Piddington, p. 3; Redfield, Am. J., 20, p. 42; Blodget, p. 398.)
 1816, late in November.—Schooner Hercules wrecked in a storm on Lake Michigan.—(Schoolcraft Nar., p. 393.)
 1819, July 26.—Excessive rain-storm at Catskill, New York.—(Am. J., 4, p. 124.)
 Nov. 9.—A very dark day on the upper lakes, Detroit, Green Bay, &c.
 Steamboat Walk-in-the-Water, first on the lakes, lost at Fisherman's Point.
 1820, June 20, 21.—Violent storm on Lake Superior.—(Schoolcraft Nar., p. 149.)
 July 1.—Storm on Lake Superior.—(Schoolcraft Nar., p. 191.)
 Sept. 9.—A gale of wind at Mackinac.—(Schoolcraft Nar., p. 403.)
 1821, Sept. 1, 4.—Storm on Atlantic coast.—(Redfield, Am. J., 20, p. 20, and 31, p. 126; Chart No. viii; Piddington; Blodget, p. 398; Barton.)
 Sept. 9.—Tornado at Warner, New Hampshire, at 5 p. m. Two others same day.—(Hubbard, Am. J., 35, p. 233.)
 1822, Aug.—Storm on the coast of the Carolinas.—(Blodget, p. 398.)
 1823, May.—Tornado at Natchez, Mississippi.—(E. Loomis, Am. J., 43, p. 289.)
 June 19.—Tornado at Morgan, Ohio, at 9½ a. m.—(Loomis, Am. J., 43, p. 298; Butler, p. 318.)
 Sept. 18, 20.—Storm on Lake Superior.—(Keating; Long's Ex., 2, p. 182 and 186.)
 1824.—Hurricane at Saint Simon's Island, Georgia.—(Lyell; 2d Vis., 2, p. 253.)
 May.—Tornado at Natchez, Mississippi.—(E. Loomis, Am. J., 43, p. 298.)
 1825, Oct. 7.—A storm and great fire, Mirimichi River, New Brunswick.—(Am. J., 36, p. 55.)
 1826, June 28.—Hurricane on the White Mountains, New Hampshire.—(Am. J. Sci., Vol. 15, p. 220.)
 Aug. 27.—Hurricane on the White Mountains, New Hampshire. Willey family destroyed.—(Am. J., 15, p. 219.)
 1827, April 12.—A storm from Upper Mississippi to Vermont, uprooting trees, &c.—(Hildreth, Am. J., 14, p. 63.)
 Aug. 17, 27.—Hurricane at Charleston 24th; New York, 27th.—(Redfield, Am. J., 31, p. 123; Chart No. iii; Blodget, p. 398.)
 1829.—A storm on the Rio Grande, Texas, causing inundations.—(Bousignes; Lieutenant Webster; Blodget, p. 398.)
 1830, March 30.—Tornado in Maury County, Tennessee.—(E. Loomis, Am. J., 43, p. 298.)
 May 31, at midnight.—A tornado at Shelbyville, Tennessee.—(J. H. Kain, Am. J., 31, p. 252.)
 Aug. 15, 19.—Hurricane, Saint Augustine, Florida, 15th; Charleston, 16th; New York, 17th; Boston, 18th; Newfoundland, 19th.—(Redfield, Am. J., 20, p. 34; 25, p. 115, and 31, p. 125; Chart No. vi; Piddington; Blodget, p. 398.)
 Aug. 22, 27.—Cape Hatteras, &c.—(Redfield, Am. J., 20, p. 39; 25, p. 115; 31, p. 125; Chart No. ix; Blodget, p. 398.)
 Sept. 29, Oct. 2.—Storm on Atlantic coast.—(Redfield, Am. J., 31, p. 125; Chart No. vii; Blodget, p. 398.)
 Dec. 5, 6.—Storm on Atlantic coast.—(Redfield, Am. J., 31, p. 126; Chart No. x.)
 1 31, Jan. 13, 15.—Storm on Atlantic coast.—(Redfield, Am. J., 31, p. 126; Chart No. x.)
 Aug. 10, 18.—Storm in Florida, Louisiana, &c.—(Redfield, Am. J., 24, p. 191, and 31, p. 123; Chart No. ii; Berlandier; Blodget, p. 398; Barton.)
 1832, May 7.—Tornado at Kingston, Mississippi.—(E. Loomis, Am. J., 43, p. 298.)
 1833, April 11.—Tornado at Springfield, Ohio.—(E. Loomis, Am. J., 43, p. 298.)
 Oct. 12.—Tornado in North Carolina.—(E. Loomis, Am. J., 43, p. 293.)
 1834, Aug. 14.—Tornado at Utica, New York, at 4 to 5 p. m.
 Sept.—Storm in Lower Texas.—(Lopez; Bousignes; Lieutenant Webster, Survey of Coast at Mouth of the Rio Grande, 1848.)
 1835, June 19, at 5 p. m.—Tornado at New Brunswick, New Jersey.—(Beck, Am. J., 36, p. 115, and Bache, Tr. Am. Phil. Soc., 5, p. 421; Hare, Tr. Am. Phil. Soc., 5, p. 375, and

- 1835, Am. J., 32, p. 153; Redfield, Am. J., 35, p. 206, and 41, p. 69; Piddington, p. 315; Blodget, p. 403.)
 June 19.—Tornado at Kinderhook, New York, at 4 p. m.
 June 19.—Tornado at Pine Plains, New York, at 6 p. m.
 June 19.—Tornado at Paterson, New Jersey, 17 miles north of New Brunswick, 8½ p. m.—(Espy, Tr. Am. Phil. Soc., 5., p. 425.)
 Aug. 12, 18.—Hurricane in Louisiana, Texas, and Mexico.—(Redfield, Am. J., 31, p. 124; Chart No. iv; Berlandier; Blodget, p. 378; Piddington; Chart No. v.)
 1835, Nov. 9, 11.—Great storm on Lake Erie, &c.—(Redfield, Tr. Am. Assoc., 1854, p. 209; Chart xi, and Am. J., 31, p. 126; Piddington.)
 1836, Dec. 20.—Storm on the lakes, &c.—(E. Loomis, Tr. Am. Phil. Soc., 7, p. 126; Pro. Am. Assoc., 1855, p. 170; Sur. Cont., vol. 11; and Am. J., 40, p. 34; Redfield, Pro. Am. Assoc., 154, p. 208; and Am. J., ii, 18, p. 186; Chart No. xxvii.)
 1837, March 18.—A northwest gale on Lake Michigan.
 July 25, 26.—A heavy storm on Lake Michigan.
 Aug. 21.—Great gale and storm on Lake Ontario; began at 7 p. m.—(Doctor E. S. Marsh.)
 Oct. 3, 12.—Hurricane, Matamoras, 3d; Galveston, 5th; New Orleans, 6th; Mobile, 7th; Charleston, 8th.—(Berlandier; Lopez; Redfield, Am. J., ii, 1, p. 166; Chart No. 15; Blodget, p. 398; Piddington; Chart No. xv.)
 Oct. 20, at 3 p. m.—Tornado at Stow, Ohio.—(Loomis, Am. J., 33, p. 368.)
 1838, July 25, p. m.—Tornado in Allegheny County, Belfast, &c., New York.—(W. Gayton. Am. J., 37, p. 90.)
 Aug. 30, between 3 and 4 p. m.—Tornado at Providence and Somerset, Rhode Island.—(Robert Hare, Am. J., 38, p. 73; Redfield, Am. J., 43, p. 263.)
 Sept.—Hurricane, Florida to Newfoundland.—(Redfield, Am. J., 35, p. 206.)
 1839, May 23.—Tornado at Maumee, Ohio.—(Loomis, Am. J., 43, p. 298.)
 July 31, at noon.—Tornado at New Haven, Connecticut.—(D. Olmstead, Am. J., 37, p. 340.)
 Dec. 15.—Storm in New Jersey, Connecticut, and New Hampshire.—(Redfield, Am. J., 42, p. 112, and ii, 1, p. 169; Chart No. xvi.)
 1840, March 24, 7 p. m.—Tornado at Mobile, Alabama.—(E. Loomis, Am. J., 43, p. 298.)
 April 23, 4½ p. m.—Tornado at Marietta, Ohio.—(S. P. Hildreth, Am. J., 41, p. 346.)
 May 3, 4½ p. m.—Tornado at Gallipolis, Ohio.—(S. P. Hildreth, Am. J., 40, p. 346.)
 May 7, 2 p. m.—A very destructive tornado at Natchez, Mississippi.—(Am. J., iii, 2, p. 98; Blodget, p. 403; Loomis, Am. J., 43, p. 298; Tooley.)
 Aug. 13.—Storm at Woodbridge, near New Haven, Connecticut.—(Piddington, p. 315.)
 Sept. 14.—Destructive thunder-storm at Oneida, Madison, and Onondaga, New York.—(Am. J. Sci., 42, p. 210.)
 1842, Feb. 4, 4½ p. m.—Tornado at Mayfield, northeast part of Ohio.—(Loomis, Am. J., 43, p. 298; Tr. Am. Phil. Soc., vol. 9; Pro. Am. Assoc., 1855, p. 181; Butler, p. 318.)
 July 12.—Storm off Cape Hatteras, Washington, &c.—(Johnston's Physical Atlas; Blodget, p. 400.)
 Storm on Gulf of Mexico, Key West, Louisiana, Texas.—(Redfield, Am. J., ii, 1, p. 17; Lopez; Blodget, p. 399.)
 Sept. 18, 22.—Storm on the Gulf of Mexico.—(Redfield, Am. J., ii, 1, p. 15.)
 Oct. 5.—Storm in North Florida, &c.—(Redfield, Am. J., ii, 1, p. 153; Chart No. xiii; Blodget, p. 399; Piddington.)
 1843, Jan. 12.—Gale on Lake Michigan at 9 p. m.
 July 28, 29.—Gale on Lake Michigan.
 Aug. 8.—Tornado in Queen Anne's County, Maryland.
 Aug. 20.—Water-spouts seen on Lake Michigan, off Kenosha.—(Lapham's Wisconsin, p. 77.)
 Sep. 24, 27.—Storm on Lake Michigan.
 1844, March 21.—Storm on Lake Michigan.
 March 28, 29.—Great snow-storm on Lake Michigan.
 Aug. 4.—Very destructive hurricane at mouth of the Rio Grande, Texas. Brazos Santiago destroyed.—(Lopez; Berlandier; Blodget, p. 399.)
 Sept. 14.—Hurricane at Charleston, South Carolina.—(Blodget, p. 399.)
 Sept. 28.—Storm and deep snow in Pennsylvania, &c.
 Oct. 2.—Storm on the Upper Lakes.—(Redfield, Am. J. Sci., ii, 2, p. 316.)
 Oct. 5, 7.—"The Cuba hurricane," Atlantic coast.—(Redfield, Am. J., ii, 2, p. 333; Chart No. iv, ii, 2, p. 162; Pro. Am. Assoc., 1854, p. 208; Chart No. xviii; Piddington's Chart, No. xvii; Espy; Thrasher; Blodget, p. 399.)
 Oct. 18.—A storm on the lakes; hurricane on Lake Erie.—(Redfield, Am. J., ii, 2, p. 321; Espy, 3d Rep.)
 Nov. 10.—Gale at Buffalo, New York.
 1845, Feb. 4, 5.—Storm in New York.—(Dewey.)
 April 1.—Gale on Lakes Michigan and Erie.
 April 7.—Snow-storm on Lake Michigan.

- 1845, April 10.—Squall on Lake Saint Clair.
 May 27.—Squall on Lake Erie.
 June 15.—Squall on Lake Michigan.
 Sept. 4.—Squall on Lake Huron.
 Sept. 11.—Gale on Lake Huron.
 Sept. 20.—Tornado on Lake Ontario.—(Dewey in Am. J., ii, 2, p. 86.)
 Sept. 23.—Gale on Lake Erie.
 Oct. 1.—Gale on Lake Erie.
 Oct. 13.—Storm on Lake Superior. Dr. D. Houghton, geologist, drowned.
 Nov. 2.—Northeast gale with snow on Lake Michigan.
 Nov. 23.—Great gale on Lakes Erie and Ontario, from the west, with snow.
 Dec. 18.—Gale at Black Rock, New York.
- 1846, June 13.—Gale on Lake Huron.—(W. W. Mather.)
 July 13.—Gale from 6½ to 10 a. m. on Lake Superior.
 Aug. 7, 9.—Storm on Lake Superior, uprooting trees, &c.—(Mather, Am. J., ii, 6, p. 4.)
 Sept. 6, 7.—Gale on Lake Superior.—(Mather.)
 Oct. 9, 14.—Storm on Lake Superior; also in Florida, Georgia, &c.—(Redfield; Blodget, p. 399, 400; Mather, Am. J., ii, 6, p. 8; Piddington, Chart. No. xx.)
- 1847, Feb. 19.—Storm at Milwaukee and New York.—(Davy; Blodget, p. 390.)
 July 25, 29.—Heavy northeast gale on Lake Michigan and Lake Superior.
 Oct. 24.—Gale on Lake Superior.—(N. Y. Reg. Rep., 1852, p. 278.)
- 1848, April 8.—Snow-storm on Lake Michigan.
 April 18.—Snow-storm on Lake Michigan.
 June 4.—Small tornado at Milwaukee, Wisconsin, at 4 p. m.
 July 30.—Storm on Lake Superior.—(Geol. Rep., p. 446.)
 Aug. 22 to Sept. 3.—Storm on the Atlantic coast.—(Blodget, p. 399.)
 Sept. 13, 14.—Storm and gale on Lake Superior.—(Geol. Rep., p. 523.)
 Nov. 29.—Northeast snow-storm and gale at Milwaukee, Wisconsin.
- 1849, March 22.—Tornado at Beardstown, Shelbyville, &c., Kentucky.
 June 23.—Hurricane in New Brunswick.
 July 29.—Severe storm on the lakes.
 Oct. 6, 7.—Storm at New York, &c.—(Blodget, p. 386.)
 Nov. 24.—Northeast storm on Lake Michigan.
- 1850, Feb. 28.—Gale on Lake Michigan.
 March 13.—Gale on Lake Michigan.
 May 22.—Storm on the lakes.—(Dewey, Reg. Rep., 1851, p. 370.)
 July 15.—Gale on the Atlantic and the lakes.—(Dewey, p. 371.)
 July 30.—Tornado at Saukville, Ozaukee County, Wisconsin.
 Aug. 23.—Hurricane in Florida.—(Blodget, p. 399.)
 Aug. 28, 29.—Gale on the lakes.—(Dewey, p. 371.)
 Nov. 26.—Hurricane in Missouri.
 Dec. 6, 8.—Storm in Western New York.—Blodget, p. 385.)
 Dec. 23.—Great snow-storm northeast to northwest.—(Dewey; Blodget, p. 384.)
- 1851, May 31.—Tornado or hurricane at Madison, Oconomowoc and Eagle, Wisconsin.
 Aug. 9.—Tornado in Connecticut.—(J. Brocklesby, Pro. Am. Asso., 1854, p. 109.)
 Aug. 13.—Hail-storm at Warren, New Hampshire.—(E. Loomis, Pro. Am. Asso., 1853, p. 73.)
 Aug. 16.—Storm on Lake Michigan.
 Aug. 22.—Tornado at Cambridge, Massachusetts.—(Brooks and Eustis; Blodget, p. 404.)
 Aug. 23, 27.—Hurricane from Florida, on Atlantic coast.
- 1852, Feb. 28, March 1.—Storm on the lakes.—(Dewey, Reg. Rep., 1853, p. 250; Espy, 4th report.)
 March 24.—Storm and gale on the lakes.—(Dewey, p. 250.)
 April 18, 20.—Great storm on the Atlantic coast.—(Dewey, p. 250.)
 April 30.—Tornado at New Harmony, Indiana.—(Chapplesmith, Sm. Cont., vol. 7; Am. J., ii, 23, p. 18; Blodget, p. 404.)
 Dec. 16, 17.—Gale on Lake Michigan in the night.
- 1853, July 1, 5 p. m.—Great hail-storm in New York City.—(Loomis, Am. J., ii, 17, p. 35; Pro. Am. Assoc., 1853, p. 56.)
 July 2.—Great storm in Wisconsin.
 Sept. 6, 16.—Storm on Atlantic coast.—(Redfield, Am. J., ii, 18, pp. 1 and 176; Blodget, p. 400.)
 Oct. 24.—Great gale on the Atlantic coast and on the lakes.—(Dewey, N. Y. Reg. Rep., 1854, p. 301.)
- 1854, Jan. 12.—Storm, Saint Louis, Chicago, &c.; also in Western New York.—(Dewey, Rep. 1855, pp. 290, 294.)
 Jan. 30.—Storm traced from Arkansas to New England. Tornado at Brandon, Knox County, Ohio.—(Am. J., ii, 17, p. 290; O. N. Stoddard, Am. J., ii, 18, p. 70; Proc. Am. Assoc., 1854, p. 188; Butler, p. 311; Blodget, p. 404.)

- 1854, Jan. 20.—Tornado in Washington County, Pennsylvania.
 Jan. 29.—Storm on the Ohio River.—(Dewey, 1855, p. 294.)
 Feb. 14.—Tornado at Harrison, Ohio.—(O. N. Stoddard, *Am. J.*, ii, 20, p. 161.)
 March 17, 18.—Snow-squalls and hurricane on Lakes Erie and Ontario.—(Dewey, 1854, p. 303, and 1855, p. 296.)
 Jan. 23.—Hurricane at Manteno, Kankakee County, Illinois.
 Sept. 9, 11.—Storm on Atlantic coast—Charleston, Norfolk, and Boston.—(Baldwin: Posey; Blodget, p. 400.)
 Nov. 13.—Storm on the lakes.—(Dewey, 1855, p. 298.)
- 1855, Jan. 4, 6.—Storm on the lakes.—(Blodget, p. 389.)
 April 2.—Great snow-storm in New York.—(Dewey, 1856, p. 344.)
 Sept. 18.—Violent gale on Lake Michigan.
 Oct. 24.—Storm on Lake Ontario.—(Dewey, 1856, p. 347.)
- 1856, Aug. 9.—Hurricane at New Orleans and Boston.—(Blodget, p. 400.)
 Aug. 25.—Northeast gale on Lake Michigan.—(Graham Harbor Report.)
 Aug. 30.—Hurricane on Gulf coast.—(Blodget, p. 400.)
 Oct. 14.—Heavy blow on Lake Michigan.—(Graham.)
 Oct. 23.—Heavy blow on Lake Michigan.—(Graham.)
 Nov. 6.—Heavy blow on Lake Michigan.—(Graham.)
 Dec. 14.—Gale from the west on Lake Michigan.—(Graham.)
- 1857, Jan. 18.—Storm on Atlantic coast.
 April 1.—Gale from the northeast on the lakes.
 June 13, 4 p. m.—Tornado at Schuyler, (near Utica,) New York.—(*Am. J.*, ii, 24, p. 290.)
 Aug. 24.—Strong gale from northwest on Lake Ontario.—(Graham.)
 Sept. 7.—Gale from northeast on Lake Ontario.—(Graham.)
 Nov. 19.—Storm at Rochester, New York.
- 1858, March 17, 18.—Storm in Ohio and New York.
 May 31.—Gale at Chicago.
 July 11, 21.—Storm on Lake Ontario.—(Dewey, *Reg. Rep.*, 1859, p. 233.)
 Aug. 18.—Heavy gale on Lake Ontario.—(Dewey, p. 233.)
 Sept. 30.—Storm on the lakes.—(Dewey.)
- 1859, March 14, 18.—Storm from Texas to New England.—(Results of Met. Obs. Smithsonian Institution, vol. 2, p. 325.)
 March 28, 29.—Gale from north and northeast on Lake Michigan.—(Colonel Graham, Harbor Report.)
 Sept. 1.—Storm on Lake Superior.
 Sept. 17, 19.—Storm on the lakes, &c.—(Results of Smithsonian Met. Obs., vol. 2, p. 331.)
 Sept. 16.—Gale on Lake Michigan.
 Nov. 25.—Storm on Lake Michigan.
- 1860, May 8.—Storm in Wisconsin.
 May 21.—Tornado at Cincinnati, Ohio.
 Nov. 1, 2.—Storm on the lakes and Atlantic.—(Dewey.)
- 1861, May 19.—Northeast storm on Lake Michigan.
 June 19.—Tornado in Champaign County, Illinois, at 4 p. m.
 July 8.—Tornado at Rockford, Freeport, Warren, &c., Illinois.
 July 8.—Tornado, at 2 a. m., at Oshkosh, Wisconsin.
 Aug. 11.—Storm and flood at Chicago.
 Aug. 14.—Hurricane at Key West.—(Hunt, in *Am. J.*, ii, 35, p. 393.)
- 1862, May 21.—Tornado at Wheeling, &c., West Virginia.
 Aug. 10.—Tornado at Dubuque, Iowa.
- 1863, Aug. 11.—Tornado at New Lisbon, Juneau County, Wisconsin.
 Aug. 21.—Tornado at Buena Vista, Portage County, Wisconsin, at 9 p. m.
- 1864, Jan. 1.—Hurricane on Lake Superior. Excessively cold weather in Wisconsin.
 Sept. 23.—Tornado at Paris and Mattoon, Illinois, from 4 to 5 p. m.
- 1865, June 29.—Destructive tornado at Viroqua, Vernon County, Wisconsin.
 June 18.—Tornado near Red Wing, Minnesota; crossed the Mississippi River at Diamond Bluff.
- 1866, May 29.—Tornado destroyed the light-house at Bay Point, Port Royal Harbor.
 June 15.—Storm and hurricane at Winona, Minnesota.
 June 17.—Gale in New York City.
 Sept. 20.—Severe gale on the lakes.
 Oct. 21.—Hurricane at Indianapolis, Indiana, from midnight to 3 a. m.
 Dec. 26, 28.—Storm on the lakes and Atlantic coast.
- 1867, Jan. 20, 21.—Great snow-storm in Middle and Eastern States.
 April 29, 10 a. m.—Tornado near Tuscaloosa, Alabama.—(H. S. Whitfield, *Am. J.*, iii, 2, pp. 99, 105.)
 July 31.—Water-spout reported on Lake Michigan this morning.
 Oct. 3.—Hurricane at Galveston, Texas.

- 1868, March 17.—Hurricane at Chatham, near Springfield, Illinois. Extended over Illinois, Indiana, &c.
 May 3.—Hurricane (or tornado) near Muscatine, Iowa.
 May.—Tornado on the Bigbee River, south of Columbus, Mississippi, and across Pickens and Tuscaloosa Counties, Alabama.—(Whitfield, Am. J., iii, 2, p. 97.)
 Aug. (177)—Hurricane at Janesville, Wisconsin.
 1869, April 18.—Tornado at Dubuque, Iowa.
 April 19.—Hail-storm at Saint Louis. Hurricane at Burlington, Iowa, Indianapolis, &c.
 May 28.—Tornado at Athens, Ohio. Hail-storm at Wheeling, West Virginia.
 Oct. 4.—Gale at Sackville, New Brunswick. Tidal wave.
 1870, Jan. 17.—Gale on Lake Erie.
 May 17.—Gale at Saint Paul, Minnesota.
 Oct. 15.—Tornado in the city of Milwaukee. A frightful tornado in Southern Ohio and Northern Kentucky.
 Oct. 21.—Tornado in the evening at Bellville, Richland County, Ohio.
 Oct. 30.—Violent southwest gale on the lakes.

PAPER G.

LIST OF DISASTERS TO SHIPPING UPON THE GREAT AMERICAN LAKES
DURING THE YEAR 1872.

JANUARY.

- 21st.—The propeller *Manistee*, damaged in the *Manistee River*, by striking a wreck left by the fire in October last.
 24th to 26th.—The steamer *Ironsides* left *Milwaukee* for *Grand Haven*, but compelled to return, being covered with ice.

FEBRUARY.

- Propeller *Favorite* broke her wheel in the ice at *Detroit*.
 8th.—Propeller *Ironsides* reached *Grand Haven* after several days' detention in the ice off that harbor.
 9th.—Propeller *Ironsides* broke her wheel in the ice on *Lake Michigan*, there being more ice than ever before known on that lake.
 10th.—Propeller *Favorite* broke her rudder in the *Detroit River*.
 23d.—Barge *Saginaw* sprung a leak at *Detroit*; 200 bushels of grain damaged.
 26th.—Steamer *Ironsides* burst her cylinder-head on her passage from *Milwaukee* to *Grand Haven*.
 27th.—Scow *Onward*, in *Detroit River*, cut through by a mass of floating ice, and sunk in 20 feet of water.
 29th.—Schooner *Len Higby* drifted ashore near *Milwaukee*, having been abandoned by the crew at *Little Point Sauble*, damaged by ice; total loss.

MARCH.

- 2d.—Tug *M. I. Mills* burned at *Amhurstburgh*, near mouth of *Detroit River*; damage \$5,000.
 3d.—Schooner *Jason Parker* driven back by a gale from *Ashnapee* to *Manitowoc*, on *Lake Michigan*.
 Ferry steamer *Detroit* broke her wheel on the *Detroit River*.
 7th.—Steamer *Ironsides* detained by ice during a violent gale on *Lake Michigan*.
 Schooner *Challenge* sprung a leak at *Ludington*, on *Lake Michigan*.
 Scow *Ellen Doak* and schooner *Jason Parker* detained by ice several weeks at *Manitowoc*.
 Propeller *Missouri*, grain, injured by ice at *Malden*, causing a bad leak.
 Steamer *Manistee* aground at *Manistee Harbor*; goods thrown overboard.
 17th.—Propeller *Ironsides* aground several hours at *Milwaukee*.
 Steam-barge *East Saginaw* damaged at *Centreville pier*.
 30th, (night).—Schooner *North Star* stranded three miles north of *Racine*, in a snow-storm.
 Schooner *Two Brothers* ashore south of *Kenosha*; crew jumped ashore from the bowsprit.
 Schooner *C. L. Johnson* damaged in the gale.
 Tug *Margaret* sunk at *Milwaukee*.
 Scow *Rough and Ready* sunk at *Toledo*.
 31st.—Propeller *Saint Joseph* had her furniture injured by rough weather.

APRIL.

- 1st.—Schooners Octavia, Union, and Toledo, slightly damaged by collision at Milwaukee.
- 4th.—Schooner J. and A. Stronach sprung a leak at Ludington, Lake Michigan; cargo discharged.
- 5th.—Propeller Saint Joseph damaged by fire at Milwaukee.
- Propeller East Saginaw ashore on the west coast of Lake Michigan.
- 6th.—Propeller Ironsides detained by fog on Lake Michigan.
- Scow Laurel, lumber, had her fore-boom broken at night.
- 8th.—Schooner Horton ashore at Michigan City.
- 9th.—Schooner Tempest filled with water and capsized at Milwaukee.
- Schooner Toledo lost jib-boom at Milwaukee.
- Schooner Worthington lost jib-boom by striking a bridge in Cleveland.
- Barge Agnes Porter aground at Milwaukee.
- 11th.—Scow Christie, wood, ashore on a rock, filled with water, on White Fish Point, north of Wolf River, Lake Michigan.
- Schooner Two Charlies, wood, struck the south pier at Milwaukee, at 11 p. m., in a southeast gale, and capsized.
- Schooner Napoleon lost jib-boom by collision with the steamer City of Toledo, at Milwaukee.
- Schooner H. F. Henry, provisions, ran aground at night on Fighting Island, in the Detroit River.
- 12th.—Propeller Truesdell damaged by contact with a bridge at Chicago.
- Scow Planet sunk in the Manistee River.
- 13th.—Barge Pilar slightly damaged at Milwaukee by contact with a bridge.
- Propeller Messenger struck a bar at Manistee, and lost rudder, shoe, and anchor.
- Scow Annie Tomine struck the pier at Sheboygan; afterward damaged by drifting against a dock.
- Scow Nettie dismasted in a gale off Bass Island, Lake Erie.
- 14th.—Scow Christie sunk in 7 feet of water at Stony Creek.
- Schooner Union lost anchor and damaged at Manitowoc.
- Schooner Game-Cock damaged at Bailey's Harbor, on Lake Michigan.
- Steamer Jay Cooke slightly damaged at Put-in-Bay, Lake Erie.
- Bark El Dorado, lumber, aground at Ludington; lightened. (Owing to low water in the lakes.)
- Schooner Eva M. Cone lost foretop on Lake Michigan.
- Scow Minnie Corlett lost two of four spars which she was towing on Lake Michigan.
- 15th.—Schooner Liberty dashed to pieces on the pier at Milwaukee early this morning, in a violent northeast gale and snow-storm. One man (Nicholas Thompson) lost.
- Scow Selt, shingles, stranded near North Point light-house, Milwaukee.
- Scow Alaska lost deck-load of wood near Milwaukee.
- Steamer Sheboygan driven back to Milwaukee by stress of weather.
- Propeller Navarino sunk at the pier at Chicago.
- Bark Acorn, schooners Sardinia and Jones, scows Chapin and Ereuca, and the bark Two Nellies damaged at Chicago.
- Schooner Kate Lyons lost canvas in the gale on Lake Michigan.
- Schooner J. Bean lost fore-boom on Lake Michigan.
- George Williams, cook, drowned from the propeller Phil Sheridan at Detroit.
- Propeller Lady Franklin, with two scows in tow, ran ashore in the Detroit River this afternoon in a violent snow-storm.
- Scow Juno, coal, driven ashore at Peninsular Point, near Marble Head light, Lake Erie, in a northeast storm.
- Schooner L. W. Perry, lumber, aground on Kelley's Island, Lake Erie.
- Schooner C. L. Johnson damaged by collision at Manitowoc.
- Schooner Charley Hibbard damaged in the gale on Lake Michigan.
- Schooner C. L. Davis damaged by collision with the schooner Sea Gem at Manitowoc.
- Fish-boat Hattie supposed to be lost, with John Babbineaux and his son, near Herring Creek, Frankfort.
- Propeller East Saginaw ashore at South Manitoo Island.
- Scow Mary Jane aground at Sandusky in a snow-storm.
- 16th.—Schooner Gipsy lost main-boom and jib-boom by collision at Chicago.
- 17th.—Bark Cambridge aground in the Detroit River.
- Schooner Industry ashore on Saint Joseph, on Lake Michigan.
- 18th.—Schooner James Couch lost jib-boom by striking a bridge at Chicago.
- Schooner Two Brothers injured by collision with the Augustus Ford at Oswego.
- Steamer Jay Cooke damaged at Detroit.
- Schooner Active ashore and full of water at Saint Joseph.
- 19th.—Tug Morey broke her wheel at Oswego.
- Tug Diana lost smoke-stack by collision with the schooner Ariadne at Oswego.
- 20th.—Scows Lime Rock and O. T. Wilcox aground in the Detroit River.

Steamer Ottawa damaged wheel in the Portage River.
 Schooner Ebenezer lost her yawl on Lake Michigan.
 Schooner S. H. Kimball and propeller Michael Groh injured by collision at Cleveland.
 Scow C. C. Bates lost scow-load of lumber on Lake Michigan.
 21st.—Schooner Speed damaged and sunk at Kenosha on Lake Michigan.
 Steam-barge Anna Laura ashore on Colchester Reef, Lake Erie.
 22d.—Schooner Eva M. Cone, wood, ashore at Port Uloa, on Lake Michigan.
 Tug Monitor seriously damaged by fire at Chicago.
 23d.—Schooner Concord aground in the Detroit River.
 Bark Alice, coal, struck a rock in the Detroit River and sunk.
 (Many accidents on account of the unusually low water of the lakes.)
 24th.—Schooner P. Hayden ashore ten miles north of Whitehall, Lake Michigan.
 26th.—Schooner Guiding Star ashore at Morgan's Point, Lake Erie.
 27.—Several vessels damaged by ice near Kingston, Lake Ontario.
 Schooner Mail ashore at Fish Point, Lake Ontario.
 Tug Lady Franklin went ashore at 2 a. m. on Gull Point, Lake Ontario.
 Schooners Irene and W. W. Grant slightly damaged by collision on Lake Ontario.
 Propeller Empire State aground on the Saint Clair Flats.
 Schooner Dane damaged by collision at Toledo.
 Barge Banner aground at the mouth of Swan Creek.
 Schooners Kate L. Bruce and H. Rand injured by collision at Chicago.
 29th.—Steamer Marine City and schooner Owaseo injured by collision at Detroit.
 Barge Birchard sunk (at night) at East Saginaw.
 Scow Louisa lost jib-boom in a blow on Lake Michigan.
 30th.—Schooner W. H. Chapman lost a spar by collision at Milwaukee.
 Scow Agnes aground in the Detroit River.
 Steam-barge McKerrell damaged by collision at Bear Creek.
 Barge Jennie Graham capsized on Lake Huron. A sailor and the cook were drowned.
 Schooner Jane McLeod ashore on East Sister Island, Lake Erie.
 Schooner Kate Gillett aground near Malden.
 Schooner Fannie Campbell, lumber, capsized in a squall on Lake Huron. The captain and two men lost.
 Tug Caroline Williams damaged by fire in the Manistee River.

MAY.

1st.—Three fish-boats capsized by the gale in Saginaw Bay; all saved.
 Vessel injured at Buffalo by ice; carried by the current in the harbor.
 Bark Lottie Wolf damaged by collision at Chicago.
 Schooner Kate Gillett hard aground at Malden.
 Scow Saint Stephen aground at Detroit.
 Schooner Eliza badly damaged by collision on Lake Michigan.
 2d.—Several barges with lumber broke away on Lake Huron, owing to the heavy sea this evening.
 Propeller Empire State aground in Milwaukee Harbor.
 Schooner Napoleon ashore near Stony Creek on Little Point Sauble, Lake Michigan.
 3d.—Ferry-boat damaged by ice between Fort Erie and Buffalo.
 Schooner E. M. Carrington, lumber, ashore at head of Belle Isle, Detroit River.
 Barge Enterprise, lumber, sunk by collision at East Saginaw.
 4th.—Schooners Fitzhugh and William Sanderson injured by collision at Port Colborne.
 Schooner Red, White, and Blue damaged by collision with the Maria Martin on the Saint Clair Flats.
 Schooner Miama Belle, salt, sunk on Raisin Reef, near Monroe, Lake Erie.
 Propeller Philadelphia damaged by ice at Buffalo.
 Schooner Saint Andrew aground in Detroit River.
 Schooner Maria Shaw, lumber, sprung a leak in the Welland Canal.
 Schooner Persia, corn, ashore at Sil Kirk Point, near Port Colborne, Lake Erie.
 Schooner Bob Wilson, barley, and William John, ballast, ashore at Northport, near Kingston, Lake Ontario.
 Schooner Onward sprung a leak in the Welland Canal.
 Schooner W. O. Brown ashore in the Detroit River.
 Schooners Evaline, Powhatan, and Czar damaged by collision on the Saint Clair Flats.
 Steamer Allegheny and two barges aground on the Saint Clair Flats.
 Schooner Jo. Vilas lost jib-boom in a blow on Lake Michigan.
 5th.—Schooner Buena Vista damaged near Chicago.
 6th.—Thomas Sexton, seaman, drowned from the schooner Jennie and Annie, near Long Point, on Lake Erie.
 7th.—Steamer Reynolds damaged on a hidden rock at Pine River.
 Schooners Jennie Mullen and Mediator injured by collision in Welland Canal.
 Barges D. P. Rhodes and G. H. Illsley aground on the Saint Clair Flats.

- Schooner Lake Breeze partially dismasted on Lake Huron.
 Schooner Eliza Fisher aground on Mill Point, Lake Ontario.
 Schooner Russel Dart, wheat, sunk at Port Colborne.
 8th.—Schooner Forest May sunk by collision with propeller Empire State, near Kelley's Island.
 Captain John Reed drowned from the bark John Breden at Buffalo.
 Bark Vanderbilt and schooners City of the Straits, Hans Crocker, and Perry Hannah damaged by grounding and collision near the mouth of the Detroit River.
 9th.—The yawl of the schooner H. C. Winslow crushed at Milwaukee.
 Tug Compound exploded her boiler and sunk near Buffalo.
 Buffalo Harbor blockaded by ice blown in by the gale.
 Samuel Krumm drowned, from the barge S. Gardner, at Bay City.
 10th.—Scows Fannie and Forest Maid sunk, by collision with the Granite State, near Kelley's Island.
 George Burridge died from injuries received from the explosion of the tug Compound.
 Propeller Nebraska broke her rudder near Marine City.
 Schooner J. B. Penfield damaged at Oswego.
 Schooner Clara Parker, coal, aground, forced ashore by ice on Rose Reef, Canada, jettisoned part of her cargo.
 Tug Wales fast on a rock at mouth of Muskoga River, Georgian Bay.
 11th.—Bark P. S. Marsh lost jib-boom at Chicago.
 Vessels injured by the gale at Cleveland.
 Barge Somerset, lumber, wrecked off Monroe, Lake Erie.
 Bark Sweet aground at Wind-mill Point, Canada, on Lake Erie.
 Bark Newsboy damaged in Detroit River.
 Schooner Star of the North, railroad ties, capsized in a squall in the afternoon, off Point au Pellee.
 Barge Orontes lost anchors in a gale on Lake Erie.
 Propeller City of Boston damaged by collision with the bark Sea Gull in the Welland Canal.
 Propeller Michigan damaged by ice on Lake Erie.
 Schooners James Platt and Mont Blanc damaged by being blown against the dock at Windsor in a squall this afternoon.
 Schooner Ashtabula damaged by collision, near Chicago.
 Tugs Bismarck and others injured by ice at Buffalo.
 Propeller Atlantic delayed twenty-four hours in the Saint Clair River.
 Steamer Union broke her shaft on Green Bay.
 Barges Dauntless and Wanda aground on Lake Saint Francis.
 Schooner Jennie Bell injured by collision at Milwaukee.
 Bark Erastus Corning compelled to lighten in crossing Saint Clair Flats, owing to low water in the lakes. (Vessels carrying lighter loads on that account.)
 12th.—Propeller Buffalo filled with water in the ice near Buffalo; was towed ashore much damaged.
 Propeller Atlantic, ashore at Elk Island, Detroit River.
 Propeller-barge Dubuque, with a tow of barges, aground in the Detroit River.
 Schooner Perry Hannah damaged at the mouth of the Detroit River.
 13th.—Tugs Miller, O. B. Greene, and Mary McLane, damaged by collision at Chicago.
 Henry McGuinn drowned from the propeller Saint Lawrence, near Kingston.
 14th.—Barge Ocean, lumber, on a reef in Niagara River.
 Schooners Tempest and Josephine ashore near Point au Pellee.
 Scow Mary Jane aground on Lake Erie.
 15th.—Schooner William Young, coal, sunk upon a reef near Buffalo, a tug entangled in ice having abandoned her.
 Propeller Winslow damaged and delayed on Lake Erie.
 Several vessels injured at Buffalo on account of the blockade of ice.
 16th.—Schooner Truman Moss dismasted in passing a bridge in Chicago.
 Schooner Wyoming sunk on the Horseshoe Reef near Buffalo.
 17th.—An easterly wind cleared the ice from the harbor at Buffalo.
 Tug Champion damaged by the ice at Buffalo.
 Schooner Josephine ashore in a dense smoke on Point au Pellee.
 Schooner Sweet Home lost a man overboard, a seaman named Kilroy, at Hamilton.
 18th.—Navigation of Lake Huron rendered dangerous by smoke of burning forests.
 Propeller Ontonagon ashore in a fog this morning in the Straits of Mackinac.
 Barge Fulton, lumber, sunk at Wenona, Lake Huron.
 Schooner Ethan Allen had cargo of corn wet in bad weather on Lake Huron.
 At 11 o'clock a wind-storm at Buffalo drove vessels back to port.
 Propeller City of Traverse hard aground on Saint Clair Flats, and again on Peach Island.
 19th.—Schooner Mary B. Hale aground on a reef and leaking.
 Schooner Levi Grant damaged by collision at Milwaukee.

- Schooner Hubbard became leaky on Lake Michigan.
 Schooner Fearless injured by running upon her anchor at Racine.
 Barge Monitor, salt, ashore at Round Island, Straits of Mackinac.
 Propeller Idaho injured machinery at Buffalo.
 Barge Empire State, lumber, aground on Squaw Island, near Tonawanda, having lost her anchor.
 Schooner Maggie, coal, ashore at Marigold's Point, Lake Ontario.
 Tug Margaret damaged by collision with schooner Napoleon, at Manistee.
 Steam barge East Saginaw disabled her machinery near Manitowoc.
 Propeller Saint Louis broke her machinery at Erie, Pennsylvania.
 Schooner Ethan Allen detained by heavy weather on Lake Erie by ice at Buffalo.
 At night the propeller Merchant, merchandise, sunk on Bar Point, near the mouth of the Detroit River. Loss, \$10,000.
 Barge Detroit aground on Peach Island, Lake Saint Clair.
 Tugs Stranger, Satellite, and Champion, broke wheels in the ice at Buffalo.
 Schooner Helen Blood lost jib-boom near Chicago.
 Schooner Hero waterlogged near Chicago.
 Schooner American lost her jib-boom at Oswego.
 Propeller East Saginaw broke down near Manitowoc.
 Schooner Tempest ashore at Point au Pellee.
 Schooners Petrel and Lorinda severely injured by collision, in a dense fog this morning, off Muskegon, Lake Michigan.
 Propeller Manistee and schooner Robinson damaged by collision on Lake Michigan.
 21st.—A number of vessels detained by grounding on the Saint Clair flats.
 22d.—Schooner Centurian ashore near Rockwell, Lake Ontario, 500 bushels wheat wet.
 Steam-barge Detroit aground in Detroit River.
 Propeller Burlington ashore on Charity Island, Saginaw Bay.
 23d.—Schooner Hattie Johnson, coal, aground in the Milwaukee River.
 Barge Fulton sunk at Winona, in Saginaw Bay.
 Schooners Arab and R. B. Hubbard arrived at Chicago leaking.
 Propeller Colorado on a rocky shore at Point Sturgeon, Lake Erie.
 24th.—Schooner S. Robinson, 16,000 bushels of corn, was run into and sunk in Lake Michigan, in a dense fog.
 Propeller Kitty Hoyt damaged by striking a log near Bay City.
 Steam-barge East Saginaw, lumber, went ashore and materially damaged on the Pancake Shoals, near Manitowoc.
 Propeller Enterprise ashore at South Bay Point.
 Schooner Mail lost jib-boom by collision at Oswego.
 Schooner Bahama broke her rudder on Lake Erie.
 Tug Sweepstakes aground at Port Edward.
 Schooner Colonel Cook ashore on Forty Mile Point, Lake Huron.
 26th.—At 10 p. m. a heavy squall on Lake Michigan.
 Schooner Flea damaged in the squall on Lake Michigan.
 Schooner Hero sprung a leak and put back to port.
 Schooner Harvest Home, railroad iron, sprung a leak on Lake Erie.
 Schooner Netta Weaver damaged on Lake Erie, at night.
 Schooner Marquette, corn, sprung a leak on Lake Ontario.
 Schooner Star of the North, railroad iron, sunk near Point au Pellee.
 Schooner Dan Tindall, lumber, ashore near Manitowoc.
 27th.—Schooners S. Bates, Mary Collins, Swallow, and Flying Cloud damaged by collision at Chicago.
 Barge Guiding Star damaged by collision with the ferry-boat Great Western, at Detroit.
 Tug H. P. Smith burned to the water's edge at Portsmouth, Saginaw River, value \$4,500.
 28th.—E. B. Sackrider jumped from the steamer Winslow and was drowned.
 Tug Frank Gule damaged by fire at Sheboygan, (\$200.)
 30th.—Schooner Josephine and tug Ransom considerably damaged by collision.
 Propeller Saint Louis aground in the new canal at Saint Clair Flats.
 Schooner Evergreen ashore in a dense fog near Saugatuck, Lake Michigan.
 31st.—Bark Nelson and schooner Page aground in the harbor at Milwaukee.
 Schooner Irene struck a rock and sprung a leak.
 The low stage of water in the lakes in the early part of the year 1872, which has caused so many of the disasters to shipping, is a direct result of the diminished rain-fall and increased evaporation of the latter part of the preceding year.
 The mean level of Lake Michigan, as shown by observations made by me at Milwaukee during the month of May, 1872, was one inch below the city zero of street grades; the average level during the same month for the past twenty-six years was one foot and five inches above that zero.
 The amount of rain-fall in September, 1871, at Milwaukee, was but little more than half an inch, while the average for twenty-nine years was nearly two inches. The amount of evaporation from the surface of an exposed basin of water during the months of September,

October, and November, was nine and three-fourths inches, while the average for the same months during ten years past was only seven and one-fourth inches.

JUNE.

- 1st.—A dense fog on Lake Michigan.
Schooner Fashion lost her jib-boom at Chicago.
Brig Pilgrim and schooner Bridgewater damaged at Chicago.
- 2d.—Brig Menomonee and schooner Atlanta damaged on Lake Michigan near Chicago.
Tug Quayle broke her crank in the Saint Croix River.
Tug Goodnow broke her crank in the Detroit River.
Schooner Alva Bradish aground in the Detroit River.
A number of vessels aground on the Saint Clair Flats.
- 3d.—Steamship Gordon Campbell aground this morning on the Saint Clair Flats.
John Goodrow drowned from the scow Buffalo on Lake Ontario.
Tug American Eagle aground at Milwaukee.
Schooner Toledo damaged by collision at Milwaukee.
Schooner Tom Simms, grain, aground at Kingston, Lake Ontario.
- 4th.—Steamer Dove damaged by fire at Malden.
Tug L. H. Boole burst her steam-pipe at Pentwater, Lake Michigan, while towing the schooner North Star, lumber: both drifted ashore, and the tug sunk.
Bark American Giant lost 25,000 staves, and became water-logged above Port Stanley.
James Keyes, sailor, drowned from the scow Joseph Wright, near Cleveland.
Steamer Kingston burned to the water's edge, off Grenadier Island, eighteen miles from Brockville; Mrs. Dr. Jones drowned.
Tug J. T. Ransom capsized in Niagara River, and Ira Hanson and — Smith drowned.
- 6th.—Propeller Cuyahoga ashore on Beaver Island.
Schooner Millard Fillmore on Hog Island Reef, in the straits of Mackinac.
- 7th.—Barge Mary Barton struck a snag, causing a leak, near Bay City.
Bark Colonel Ellsworth, corn, ashore near Point Albino and filled with water in thick foggy weather, at night.
Schooner Jennie Graham capsized, and one of her crew drowned.
Schooner Forwarder struck by a heavy squall on Black River, Lake Erie, and damaged.
- 8th.—Schooner Philo Scoville, coal, becalmed, and drifted upon Rose's Reef, near Buffalo.
- 9th.—Tug Bismarck broke her wheel at Racine.
Barge Emma E. Tyson ran aground at Racine and became leaky; 2,000 bushels corn wet.
Propeller Union lately ashore on Strawberry Reef, Green Bay, now on Laughing Whitefish Reef, twenty-four miles below Marquette, Lake Superior, at 2 a. m., in a dense fog.
- Schooner C. Mears aground at Buffalo.
Schooner Cascade ashore on Laughing Whitefish Reef, Lake Superior.
- 10th.—Steamer Mary Ward hard aground at mouth of the river Thames.
Schooner Moses ashore in the Detroit River.
Schooner Canadian lost her jib-boom by collision with the Frank D. Baker at Oswego.
- Scow Aunt Ruth ashore six miles above Round Eau.
- 11th.—Scow A. Ruat damaged by collision at Chicago.
Bark Racine, railroad iron, sprung a leak on Lake Erie and returned to Buffalo.
- 12th.—Propeller Cuba hard aground in old channel, Saint Clair Flats.
Steamer Clara damaged by collision in Detroit River.
- 13th.—Two tows aground on the Saint Clair Flats.
Scow Martin damaged by lightning shortly after noon at Windsor.
Tug Frank Geele slightly damaged by fire at Sheboygan.
Bark Sweepstakes struck an obstruction in Saginaw Bay and filled with water.
A remarkable tidal wave on the lakes on the 12th and 13th. At Oswego at 3.30 p. m. of the 13th.
- 14th.—Steam barge J. S. Fay aground on the flats of Saint George, Sault River.
Vessels hindered by dense fog on the lakes on the 13th, 14th, and 15th.
- 16th.—Steamer Alpena aground on the shore of Lake Michigan.
Schooner Forwarder, lumber, aground in Detroit River.
- 18th.—Schooner Glen Cuyler, staves, lost foremast by collision with the scow Hunter at Manitowoc.
Propeller J. L. Hurd aground several days in South Reach, Saint Clair River.
- 19th.—Schooner Alvin Bronson damaged by collision at Chicago.
Propeller Missouri, salt, aground in Saginaw River.
Bark Tanner, coal, aground on Two Rivers Point, Lake Michigan.
Schooner Mary Hattie, lumber, ashore in Detroit River.
Schooner Gem of the Lakes, brick, sunk at Cleveland.
- 20th.—Schooner Jamaica struck (at mast-head suddenly, at noon, without warning) by a tornado and instantly capsized, off Rock Falls on Lake Huron. Eliza Headington drowned. Eighteen thousand bushels of wheat damaged.

Scow Mountain Maid, coal, became leaky on Lake Erie.

Barge Saginaw, timber, struck an obstruction near Saint Catharine's and sunk.

Schooner Lucinda Van Valkenburg and an unknown vessel lost all their canvas in a tornado on Lake Huron.

21st.—Tug Hunter sunk in 8 feet of water by collision on Lake Huron.

22d.—A fleet of vessels passed Detroit, having been detained by calms and fogs for whole days; some were leaky.

Schooner Imperial, lumber, damaged by collision with the bark J. S. Austin, near Death's Door, Lake Michigan.

Schooner Portland, grain, ashore on Colchester Reef, Lake Erie.

Steamer Mason and barge American Giant, staves, aground on Carrolton Bar, Saginaw River.

Bark J. S. Austin struck by lightning this morning in the straits of Mackinac; two men injured.

Michael Morrissey, engineer of the tug Magnolia, drowned at La Salle.

23d.—An unknown vessel lost her jib-boom by collision with the schooner Delas De Wolf on Lake Michigan.

Tug L. B. Johnson and steam barge East, Saginaw damaged by collision at Chicago.

Canal-boat Russel Smith, lumber, capsized and lost deck-load at Buffalo.

Tug Bob Anderson broke both her cylinder-heads on the Saint Clair River.

Tug Niagara exploded her steam-pipe at Detroit. James De Orsay, deck-hand, killed.

Schooner Algerine, iron ore, damaged by collision with steam-barge Robert Hollen at Cleveland.

24th.—Bark J. S. Austin, coal, damaged by collision on Lake Michigan, near Milwaukee.

Schooner Toledo crushed her yawl in the Milwaukee River.

Schooner William G. Grant, coal, sprung a leak on Lake Michigan.

Schooner Mary struck a snag in Lake Michigan, slightly damaged.

25th.—Schooner Louise Meeker damaged by striking a bridge at Chicago.

Schooners Azov, Apprentice Boy, and Montauk damaged by collision at Chicago.

Propeller Rocket aground in East River, Green Bay, in a fog.

Steamer Marine City ashore near Bark Shanty, Lake Huron.

27th.—Bark City of Painesville, iron ore, ashore on Eleven-Mile Shoal, near Escanaba, Green Bay.

Tug Mystic broke her crank-pin near Port Huron.

28th.—Propeller Georgian damaged by fire at Buffalo.

Tug Merchant sunk by collision with the propeller Ironsides at Grand Haven.

Propeller Peerless ashore near Bay City.

29th.—Schooner Japan, lumber, ashore near Spider Island, Lake Michigan.

Barge Crow ashore at Stony Island.

Propeller Jay Gould aground at Ecorse.

30th.—Bark City of Milwaukee lost her mizzen-mast by collision with the schooner L. S. Hammond at Milwaukee.

Propeller S. D. Caldwell ashore at Mackinac.

Tug Benton, damaged by fire at Saginaw River.

JULY.

1st.—Propeller Montana, wheat and flour, aground at Milwaukee.

Schooner W. J. Whaling lost jib-boom by collision in the Chicago River.

Propeller East aground in the Middle Channel, opposite Ganaogne, and became leaky.

2d.—Tug Jennie Bell damaged by being struck by the propeller Philadelphia at Detroit.

Steamer Grace Downer (sixty-eight tons) burned to the water's edge at Beaver Island; George Burrows, mate, burned to death.

3d.—Tug J. U. Masters damaged her machinery at Port Huron.

Schooner Sea Bird slightly damaged by collision at Detroit.

4th.—Propeller B. F. Wade ashore at Waukegan.

Tobias Tounessen drowned from the schooner Geo. C. Finney at Kingston.

5th.—Scow Hanson, 12,000 bricks, cut in two and immediately sunk by collision with the propeller Toledo at Port Huron.

6th.—Barge Louisa Bun sunk in Chicago River.

Schooner Herald water-logged by collision with the schooner Ketchum off Chicago.

Propeller Gordon Campbell damaged by a log in her wheel at Milwaukee.

Propeller City of Cleveland had her cargo of wool mattresses accidentally saturated with linseed oil causing spontaneous combustion.

8th.—Scow Sea Bird lost both masts and bowsprit by collision at Detroit.

Tug Kate Moffatt broke her machinery and was towed to Detroit.

Tug W. A. Moore broke her wheel at Buffalo.

Propeller St. Lawrence broke her piston-head at Kingston.

Propeller Java stove a hole in her bow at Cleveland; she afterward broke her machinery, and went to Detroit for repairs.

- 9th.—Steam-barge Henry Howard broke her bed-plate at Port Huron.
 William Barry, sailor, drowned from the schooner Minnie Slauson, near Big Summer Island, Green Bay.
- 10th.—Propeller W. M. Tweed aground three hours at Chicago.
- 12th.—Propeller Bertschy loosened her wheel at Depere, and was towed to Milwaukee.
- 13th.—John Leitch drowned from the steam-barge Wm. Cowie at Saint Clair.
- 14th.—Tug H. N. Martin damaged her wheel at Cleveland.
- 15th.—Schooners Whirlwind and Col. Glover damaged by collision at Milwaukee.
- Tug Sol Rummage disabled machinery near Detroit.
- Tug Scott broke her wheel on a sunken log at Cleveland.
- 16th.—Steamer Metropolis damaged at Pentwater.
- Propeller Truesdell broke her machinery on Green Bay; towed to Escanaba.
- Bark Nelson struck upon a reef in the Straits of Mackinac.
- 17th.—Steamer Manitoba struck a rock near Michipicoten Island, Lake Superior, and sunk in 12 feet of water.
- Steam barge Glascon hard aground on Saint Clair Flats.
- Steamer Evening Star broke her piston-head on Lake Erie.
- Bark H. Bissell struck a rock in the Niagara River, causing a leak.
- 18th.—A tow of barges seen adrift off Forestville, Lake Huron.
- Tug Champion burned and scuttled at Detroit.
- A fish-boat struck by a squall near Mackinac and damaged; men exhausted.
- Steamer John Sherman ashore in Detroit River.
- Thomas Halbrook drowned from the propeller Fountain City, near Charlevoix.
- Scow Ino dismasted in a north-northwest storm on Lake Erie, off Ashtabula.
- Steam-barge Henry Howard disabled on Lake Huron.
- Schooner Pelican aground on the Saint Clair Flats.
- 20th.—Scow Nellie damaged by collision with the schooner J. B. Wilber, in the Saint Clair River.
- Schooner Anglo Saxon ashore at Forty Mile Point, Lake Huron; jettisoned railroad iron.
- Steam-barge Henry Howard, lumber, broke her machinery on Lake Huron.
- Steam-barge Charles Reitz broke her wheel near Gratoit.
- Schooner C. G. Breed, coal, aground on a reef at Fox Point, twelve miles north of Milwaukee.
- Tug Tempest lost a scow, laden with machinery, in a fog near Copper Harbor, Lake Superior, which is supposed to be foundered.
- 21st.—A son of Julius Sumner drowned from the propeller Pacific, in Saginaw Bay.
- Tug Hunter sunk by collision in 8 feet of water in Lake Michigan.
- 22d.—Propeller Orontes broke her shaft at Harrisonville on Lake Huron.
- Tug Harrison capsized near Chicago.
- Barge Robert Emmett lost part of her deck-load of staves in a squall on Lake Huron.
- Barge Jesse Drummond lost jib-boom, and became leaky by collision on Saint Clair Flats.
- A raft of timber broken up by heavy weather on Lake Huron.
- 23d.—Schooner D. L. Couch, coal, sunk off Long Point, Lake Erie.
- 24th.—Barge J. S. Austin aground at Milwaukee.
- Bark Sardinia and barge Iron City damaged by collision at Buffalo.
- Scow Butcher-Boy lost an anchor on Lake Erie.
- Steam-yacht Eva Wadsworth, ashore on Peach Island, St. Clair River.
- Schooner S. and J. Collier lost maintopmast in a squall on Lake Ontario.
- Propeller Benton broke her wheel on Carrolton Bar, mouth of Saginaw River.
- Propeller Philadelphia (drawing 13½ feet of water) struck bottom near Grasse Point light, Lake Saint Clair.
- John Bassett drowned from the steamer Chicora in Georgian Bay.
- 26th.—Brig Mechanic damaged by striking a bridge at Milwaukee.
- Schooner Pelican, ore, aground on the Saint Clair Flats.
- Tug Home ashore at Calumet, Lake Michigan.
- Schooner Wanderer ashore at Stony Reef, Detroit River.
- Schooner Black Duck, coal, foundered in deep water in Mexican Bay, Lake Ontario.
- Total loss.
- 27th.—Scow Ino damaged by collision with the schooner Long Simms.
- Schooner Jennie Bell damaged against a bridge at Milwaukee.
- Goldsmith drowned from the revenue-cutter Commodore Perry at Buffalo.
- Scow Lea sprung a leak near Milwaukee.
- 28th.—Schooner Ellington, staves, ashore at Fairport, Lake Erie.
- John Doyle drowned from schooner Rising Star at Chicago.
- John Heare drowned from steamer Marine City on Lake Erie.
- John Childs drowned from the barge Harvest at Cleveland.
- Schooner Theodore Perry, coal, damaged by collision with a propeller on Lake Erie.
- Thomas Fleming drowned from the schooner L. B. Crocker at Port Colborne.

29th.—Propeller Mary R. Robinson, 15,000 bushels wheat, burned near Wangoshance light on Lake Michigan.

30th.—Propeller Lake Michigan aground on a shoal at Ganaganogue, Canada.

Schooner What Ye Call It lost her foremast in a squall at Detroit.

— Shields drowned from the schooner Webb at Erie, Pennsylvania.

31st.—A seaman from the barge Globe drowned in Tawas Bay, Lake Huron.

A barge towed by the propeller Edith became water-logged off Tawas Bay, Lake Huron.

Steamer City of Montreal damaged her machinery near Windsor.

A raft broke loose in rough weather from the tug Clematis off Point Austin, and was driven upon the beach.

AUGUST.

2d.—Schooner Truman Moss dismantled by collision at Chicago.

Schooner Evening Star lost head-gear by running against a bridge in Chicago.

Scow Home broke from the pier at Free Soil, on Lake Michigan, at 6 p. m., during a norther, and went ashore.

Propeller Chicago Belle sunk at Manitowoc.

Schooner Libbie Nan aground in Green Bay.

Bark Jesse Drummond had her cargo damaged by water on Lake Ontario.

Schooners Star of Hope and Florida damaged by collision on Saint Clair Flats.

Steam canal-boat S. D. Gibson, iron-ore, aground and filled with water on Ford's Shoal, near Oswego.

Barge Seminole, lumber, became water-logged at Tawas, Lake Huron.

Schooners Eliza White and Octavia damaged by collision at Oswego.

4th.—Thomas Morgan drowned from the propeller Tioga, ten miles off Long Point, Lake Erie.

Schooner Fearless, lumber, capsized and filled off White Fish Point, near Manitowoc, at 2 p. m.

Charles Smith drowned from the schooner Welland, at Chicago.

Schooner Capella lost jib-boom at Manitowoc.

Schooner Colonel Hathaway, coal, hard aground in the Detroit River.

Propeller China hard aground in the Neebish, Sault River.

6th.—Fishing-smack Clara lost her canvas in a squall on Green Bay.

Tug Black Ball disabled at Chicago.

A scow took fire in the cabin near Detroit.

Tug Babcock sunk at Chicago.

Schooner Mary Nan had her foremast shivered by lightning at Green Bay, at night.

Scow F. L. Jones lost center-board on Lake Erie.

Propeller Badger State aground in Saint Clair River.

7th.—Steam-barge Concord broke her machinery on Lake Erie.

Steamer Ajax burned to the water's edge near Bay City.

8th.—Tugs New Era and J. T. Ransom sunk at Tonawanda.

Bark Martin, wheat, sunk by collision with a schooner near Long Island, Lake Ontario.

9th.—Tug Bob Anderson broke down off Forestville, Lake Huron.

Schooner Bessie Boalt lost her rudder on Lake Michigan.

Schooner Golden Fleece aground on Saint Clair Flats.

Lighter America lost 300 barrels salt overboard by collision with a bridge at East Saginaw.

Schooners S. S. Osborn and American Union much damaged by collision near Fox Island, Lake Michigan.

Tug Danforth burned to the water's edge at Du Luth, Lake Superior, and sunk in 18 feet water.

Schooner Ardent and bark Sardinia damaged in squalls on Lake Michigan.

Steam-barge Ira H. Owen, iron-ore, sprung a leak.

Scow Clara, coal, ashore at Stoney Island, in the Detroit River.

10th.—Schooner Delaware and bark Sardinia aground at Milwaukee.

Schooner Island lost a gaff in heavy weather on Lake Michigan.

Schooner J. S. Walter aground at Milwaukee.

Schooner Midnight ashore at Racine.

Bark John Breden, coal, sprung a leak near Buffalo.

Schooner John Tibbits damaged by collision with the propeller Vanderbilt at Buffalo.

11th.—Propeller Thomas A. Scott aground at Milwaukee.

John Coggriff drowned from the schooner O. S. Storrs, at Oswego.

12th.—Captain Elijah Blanchard drowned from the schooner Active, at Oswego.

Bark Zack Chandler had mast damaged by lightning off Point Betsey, Lake Michigan.

13th.—Steamer Margaret ashore in the Ducks, in Lake Ontario, on a dark night.

Schooner Berlin lost jib-boom at Toledo.

Schooner American Union damaged by collision with schooner Osborne on Lake Michigan.

14th.—Schooner Dayspring, wood, struck by lightning off Ashnapee, Lake Michigan; L. Mueller seriously injured, and Tobias Tobiasen instantly killed.

- Propeller Lake Michigan aground on a shoal off Kingston.
- 16th.—Schooner Josephine Lawrence capsized and sunk, by collision with the propeller Favorite, near Two Creeks, Lake Michigan, in a dense fog.
- Charles Hill drowned from the schooner Midnight, at Racine.
- Steamers Corsican and Watertown damaged by collision near Kingston.
- Schooner Edwin Blake, 19,000 bushels wheat, aground on Point Frederick Shoals.
- Bark Saginaw, timber, sunk at Saint Catharine's, Lake Ontario.
- 17th.—Captain Waggoner, of the barge Severn, drowned at Cleveland.
- Schooner Len Higby had her topmast broken on Lake Michigan.
- Steamer Detroit damaged by collision with the propeller Thomas A. Scott, at Detroit.
- 18th.—Philip Nolan, of the barge Susan Ward, drowned on Lake Erie.
- Daniel Elois, of the Tug Star, drowned in Saginaw River.
- Luke Sky, of the barge Hotchkiss, drowned at Buffalo.
- 19th.—Steamer Favorite damaged by collision at Detroit.
- Brig Helfenstein, salt, arrived at Detroit leaking.
- Schooners American Union, ore, and S. P. Ely, damaged by collision in a dense fog, at Port Huron.
- Scow Industry, walnut lumber, found water-logged and abandoned on Lake Erie; towed to Cleveland.
- 21st.—Scow Pierrepoint and propeller Mohawk damaged by collision at Detroit.
- Tug J. H. Martin broke her machinery; towed into Detroit.
- 22d.—Bark C. K. Nims, 33,000 bushels corn, struck a reef at Bar Point, Lake Erie.
- Schooner Monterey struck a rock, and damaged.
- Schooner Middlesex sprung a leak at Marquette.
- Schooner Sophia Smith damaged by collision near Detroit.
- Steamer W. R. Clinton damaged on a rock at Grindstone City.
- 24th.—Propeller Cuba aground at Milwaukee.
- Schooner Welland ran against the pier at Muskegon, was crushed, filled with water, and capsized.
- Scow Snowbird injured and sunk, by a blast intended for the removal of rocks in the Detroit River.
- Mr. ——— McDonald drowned from the steamer W. R. Clinton on Lake Huron.
- Scow Maria sprung a leak on Lake Huron.
- 25th.—Propeller Bertachy burned at Depere, near Green Bay, loss \$8,000.
- Charles Hendrickson drowned from schooner Dayspring, at Ahnapee, Lake Michigan.
- Tug J. D. Dudley ashore at Fairport, Lake Erie.
- 26th.—Schooner David Stewart, ore, hard aground on the Saint Clair Flats.
- Schooner Narragansett lost canvas in a squall on Lake Erie.
- Schooner Columbia, coal, aground in Detroit River.
- A scow driven ashore on Lake Huron, near the entrance of the Saint Clair River.
- 27th.—Schooner Lewis Ludington lost jib-boom at Chicago.
- 28th.—A northeast storm on Lake Michigan to-day, driving many vessels into port for shelter.
- Scow Ida H. Bloom struck a pier at Milwaukee and lost jib-boom.
- Several small sail-boats lost or damaged at Milwaukee.
- A canal-boat sunk, and another damaged, in the Niagara River.
- Schooner Louie Meeker, 22,000 bushels of oats, struck by a squall at 10 a. m., ten miles from shore, near Point Sauble, Lake Michigan, capsized and sunk. Captain Robert West, Robert West, jr., Charles Baker, E. Nelson, and the steward were drowned.
- Schooner Glad Tidings lost jib-boom in the gale on Lake Michigan.
- Scow Minnie Corlette, shingles and piles, damaged at Waukegan.
- 29th.—Schooner Garibaldi had sail torn by a bridge at Milwaukee.
- Michael Neupert drowned from the tug Ballentine, at Bay City.
- Schooner Angeline lost mainsail in a squall.
- Schooner J. R. Sanburn split her mainsail and fore-topsail.
- Schooner Cortland had canvas blown away.
- Schooner Almira damaged on the piers at Cleveland.
- Scow J. W. Porter ashore at Clough's Pier.
- A raft of logs broke loose from a tug at Cleveland and washed ashore.
- 30th.—Barge El Dorado broke her steering gear, and was towed into Milwaukee.
- Brig Waucoma, iron, sprung a leak near the Manitous, Lake Michigan.
- Schooner Delos De Wolf, grain, sprung a leak on Lake Michigan.
- Schooner Sea Gem damaged at the pier at Maumetee.
- Tug Louie Dole damaged by collision with the tug Black Bell, off Chicago.
- Scow C. C. Butts sunk at Kenosha.
- Schooner G. J. Whitney, stone, ashore, and full of water, at Vermillion, Ohio.
- A number of vessels aground on the Saint Clair Flats, owing to the low stage of the water.
- Schooner Alpha, lumber, wrecked at 5 p. m. on a reef near Four-Mile Point, Lake Ontario.
- Schooner Orion sunk at Long Point, Lake Erie.

Schooner Richardson ashore at Presque Isle, Lake Erie.
 Propeller Buckeye broke her engine on Lake Ontario.
 Schooner Odd Fellow, lumber, lost mainsail and a portion of her cargo.
 A severe northwester on Lake Huron; vessels unable to proceed, anchored along the coast.
 Schooner Franconia, pig-iron, sprung a leak on Lake Huron.
 Scow J. F. Porter stranded on south shore of Lake Erie.
 Schooner Montauk and Bark Pathfinder lost jib-booms at Port Huron.
 Propeller Toledo had her gangways dashed in on Lake Huron.
 Schooner C. P. Minch aground at Port Huron.
 Scow Hannah lost jib-boom by collision, on entering the Saint Clair River.
 Schooner Governor damaged at the pier and grounded at Oswego.
 Schooner Two Brothers lost 16,000 feet of lumber on Lake Ontario.
 Schooner Olivia lost 6,000 feet of lumber on Lake Ontario.
 Revenue-cutter Chase lost anchor and chain on Lake Ontario.
 A seaman drowned from the Barge Toledo, at Kingston.
 Brig Ocean, stone, sunk in Lake Ontario.
 Schooner Vancouver, pig-iron, sprung a leak on Lake Ontario.
 31st.—Barks William Howe and Prince of Wales ashore near Port Dalhousie, Lake Erie.
 Schooner Fanny Campbell disabled near Point au Pelles.
 Bark Alexander, timber, sprung a leak off Long Point.
 Schooner Augustus Ford, coal, sprung a leak on Lake Erie.
 Schooner Erie sunk while at anchor at Marblehead, Lake Erie.
 Schooner Amoskeag struck in Sault Ste. Marie River, and sprung a leak.
 Schooner Eliza White damaged by fire at Oswego.
 Brig Gen. Worth lost foremast off the Scotch Bonnets.
 Barge Argo lost lumber and shingles overboard on Lake Ontario.
 Scow Ida and Mary, stone, ashore, at night, on Sturgeon Point, Lake Erie.
 Propeller City of Madison damaged and driven back to Marquette, Lake Superior, by the storm.

PAPER H.

METEOROLOGICAL OBSERVATIONS MADE AT MOUNT WASHINGTON, N. H.,
 DURING THE MONTH OF MAY, 1872.

OFFICE OF THE CHIEF SIGNAL-OFFICER,
 Washington, D. C., July 10, 1872.

SIR: I have the honor to submit the following report of meteorological observations made in compliance with your orders at Mount Washington, New Hampshire, from May 1 to May 31, 1872, during which time a special station, established at the railroad depot, near the base of the mountain, was in telegraphic communication with the permanent station at the summit.

Fifteen observations were made daily at both stations at hourly intervals, and especial pains taken to have them made synchronously. (Papers A and B.)

Instruments used at Summit Stations.—Barometer, Green's standard No. 1797; instrumental error,—.005; thermometer, Green's mercurial; hygrometer, (Glaisher's model;) anemometer, Robinson's; rain-gauge, signal-service model.

At base of mountain.—Barometer, Green's, No. 1914; instrumental error,—.002; thermometer, Green's; hygrometer, Glaisher's; anemometer, Robinson's, with Gibbon's self-registering attachment; rain-gauge, signal-service model.

Observers.—Summit station: Sergeant A. R. Thornett, signal-service, United States Army; Private R. J. Bell, signal service, United States Army. Lower station: Sergeant Theodore Smith, signal service, United States Army; Private J. H. Garrad, signal service, United States Army.

Attention is invited to the special report of Sergeant Smith, (Paper C,) and to the daily journals kept at both stations, (Papers D and E.)

Paper F exhibits, in tabulated form, the daily observations made at the mountain stations, and Paper G those made at Portland, Maine, for the same period of time, at an elevation of 54 feet above mean-tide level. Of the Portland observations, those made at 8.2 a. m., 5.2 p. m., and 12.2 a. m. are synchronous with those made on the mountain stations at 7.57 a. m., 4.57 p. m., and 11.57 p. m.

Very respectfully, your obedient servant,

H. W. HOWGATE,
 Second Lieutenant and Brevet Captain, United States Army,
 Acting Signal-Officer and Assistant.

Brigadier-General ALBERT J. MYER,
 Chief Signal-Officer of the Army.

Paper A.

WAR DEPARTMENT, OFFICE OF CHIEF SIGNAL-OFFICER,
DIVISION OF TELEGRAMS AND REPORTS
FOR THE BENEFIT OF COMMERCE,
Washington, April 20, 1872.

SERGEANT: A special series of observations at the base of Mount Washington, in connection with the station on the summit, will be made, under your supervision, during the month of May next, beginning at 6 a. m. of the 1st and terminating at 11.57 p. m. of the 31st of the month. These observations will be the same in all respects as those taken at regular stations, and will be entered in the same manner upon Form 4, and will be brought by you in person to this Office when called in, unless otherwise ordered.

The observations will be made at the following hours, (local time :) 6 a. m., 7 a. m., 7.57 a. m., 9 a. m., 10 a. m., 11 a. m., 12 m., 1 p. m., 2 p. m., 3 p. m., 4 p. m., 4.57 p. m., 6 p. m., 9 p. m., 11.57 p. m.

Upon your arrival at the base of the mountain you will put yourself in telegraphic communication with the observer on the summit, and will, if practicable, keep this communication unbroken during your occupation of the station. The observation at each station must be synchronous, and, in order to effect this, the time-pieces at both stations must be kept carefully adjusted with each other by comparing them three times each day, (by telegraph,) at intervals of eight hours. Five minutes before the time of each observation you will call the observer at the summit, and, after getting his acknowledgment, will prepare for taking the observation. The signal for reading the barometer will be given from your station one minute before the time. The instruments will be read in the following order: 1st, attached thermometer; 2d, barometer; 3d, thermometer; 4th, hygrometer; 5th, anemometer; 6th, wind-vane; 7th, rain-gauge.

It is expected that both observers and assistants at both stations will unite in doing this special work accurately and promptly, as the anticipated results will be of general scientific interest.

Very respectfully,

H. W. HOWGATE,
*Second Lieutenant and Brevet Captain, United States Army,
Acting Signal-Officer and Assistant.*

Sergeant THEODORE SMITH,
Base of Mount Washington, New Hampshire.

Paper B.

WAR DEPARTMENT, OFFICE CHIEF SIGNAL-OFFICER,
DIVISION OF TELEGRAMS AND REPORTS
FOR THE BENEFIT OF COMMERCE,
Washington, D. C., April 18, 1872.

SERGEANT: A special series of observations will be made at your station, in connection with an observer at the base of the mountain, during the month of May; beginning at 6 a. m. of the 1st and terminating at 6 p. m. of the 31st, and at the following hours: 6 a. m., 9 a. m., 10 a. m., 11 a. m., 12 m., 1 p. m., 3 p. m., 4 p. m., and 6 p. m. These special observations will be the same in all respects as those taken at the regular hours, and will be entered in the same manner upon Form 4, but on separate sheets from the two regular series. They are not for telegraphic transmission, but will be sent by mail to this Office at the end of the month. These observations must not interfere with the regular reports, which will be taken, recorded, and transmitted as usual. The observer at the base of the mountain will be in telegraphic communication with the summit, and the observations at both stations must be synchronous. To effect this, the observers will keep their time-pieces carefully adjusted with each other, making a comparison three times each day, (by telegraph,) at intervals of eight hours. Five minutes before the time for each observation the observer at the lower station will call the observer at the summit, who will promptly acknowledge the call, and get ready for work. The signal for reading the barometer will be given from the lower station one minute before the time. The instruments will be read in the following order: 1st, attached thermometer; 2d, barometer; 3d, thermometer; 4th, hygrometer; 5th, anemometer; 6th, wind-vane; 7th, rain-gauge.

It is expected that both observers and assistants will unite in doing this work accurately and promptly. The observer at the lower station will take observations for record at the same times as the regular observations are taken at the summit station.

Very respectfully, &c.,

H. W. HOWGATE,
*Second Lieutenant and Brevet Captain, United States
Army, and Acting Signal-Officer and Assistant.*

Sergeant A. R. THORNETT,
Mount Washington, New Hampshire.

Paper C.

WASHINGTON, D. C., June 8, 1872.

SIR: I have the honor to submit the following report in reference to the work at the temporary station at the base of Mount Washington, New Hampshire, during the month of May, 1872:

I arrived at the station on the evening of April 25, but the two cases containing the different instruments to be used there were still at Littleton, New Hampshire, as the roads were impassable for heavy teams. Captain J. W. Dodge, the manager of the Mount Washington railway, engaged a team at Bethlehem to bring provisions and my instruments at all hazards on Friday, April 26, and by using eight horses they succeeded in reaching the base of the mountain the following day. I found the instruments in pretty fair condition under the circumstances, as only two glass jars of the Daniell battery and two porous cups of the Le Glanche battery were broken.

Immediately upon my arrival I placed myself in telegraphic communication with the observer at the summit of Mount Washington, using six cups of the Daniell battery, and Littleton office put up a separate battery for the main wire, connecting me with Concord and Boston at report hours; and, also, regularly every night after 8 o'clock. The wire to Littleton had been kept in fair condition during the winter by Mr. Ranlet, of Bethlehem, but the cable to the summit worked very hard, owing to imperfect insulation. The observer at the summit was unable to break any station during rain-storms, and after the snow upon the trestle-work of the railway commenced to melt, and therefore I concluded to divide and relay his reports whenever it would be necessary.

Sunday, April 28, was occupied in putting up the instruments. During the afternoon, Sergeant A. R. Thornett came down from the summit, and we made the necessary arrangements for carrying out the instructions received from the Chief Signal-Office in regard to our special observations.

I divided the hours of duty between myself and assistant, Private J. H. Garrard, in such a manner that whoever took the night observations was to take the afternoon observations on the following day, thus giving twelve hours of duty to each; but whenever the wire worked hard, and I was not on duty at midnight, my assistant was to waken me for relaying the midnight reports. The signal for reading the barometer, &c., was given from my station by calling Mount Washington five minutes before the hour of observation, and then making single dots one-half minute before, and double dots at the exact hour, then reading the barometer the instant the acknowledgment was received from Mount Washington. I had given my assistant sufficient instructions in the use of the Morse code for giving these signals, and this plan was kept up during the entire month with but few interruptions, which were caused by the bad condition of the cable. The time-pieces at both stations were adjusted three times each day, at intervals of eight hours, according to instructions.

The different meteorological instruments were exposed as follows:

Barometers in a room on the second floor of the depot building, about 24 feet above the surrounding ground; thermometer and hygrometer outside of a window of the same room, facing the north, being well sheltered by the large projecting roof of the depot building; the anemometer and anemoscope on the roof of the old log cabin, standing south of and about 20 feet higher than the depot; the rain-gauge in a clearing some 40 feet from the buildings on the ground.

The instruments worked well and remained in good condition during the month, and the barometer I used was from time to time compared with the additional one I had, both instruments reading alike.

In obedience to orders received from the Chief Signal-Officer, I left the station on the morning of June 2, arriving at Washington on the evening of June 4.

Very respectfully, your obedient servant,

THEODORE SMITH,

Observer-Sergeant, Signal Service, United States Army.

Captain H. W. HOWGATE,

Acting Signal-Officer and Assistant.

Paper D.

ABSTRACT OF DAILY JOURNAL FOR THE MONTH OF MAY, 1872.

April 30.—Day opened with cold and fair weather. Barometer, high and steady since yesterday afternoon. Temperature, 22° at 6 o'clock a. m. Wind, west and light. Sky covered with about one-fourth cirrus clouds moving rapidly from the northwest. Very clear around the summits of Mounts Washington and the Green or Franconia ranges. Hazy in the west. Wind increased somewhat toward noon; but barometer remained unchanged; temperature rising very rapidly, being 51° at 1 o'clock p. m. Commenced clouding up in the

- Propeller Lake Michigan aground on a shoal off Kingston.
- 16th.—Schooner Josephine Lawrence capsized and sunk, by collision with the propeller Favorite, near Two Creeks, Lake Michigan, in a dense fog.
- Charles Hill drowned from the schooner Midnight, at Racine.
- Steamers Corsican and Watertown damaged by collision near Kingston.
- Schooner Edwin Blake, 19,000 bushels wheat, aground on Point Frederick Shoals.
- Bark Saginaw, timber, sunk at Saint Catharine's, Lake Ontario.
- 17th.—Captain Waggoner, of the barge Severn, drowned at Cleveland.
- Schooner Len Higby had her topmast broken on Lake Michigan.
- Steamer Detroit damaged by collision with the propeller Thomas A. Scott, at Detroit.
- 18th.—Philip Nolan, of the barge Susan Ward, drowned on Lake Erie.
- Daniel Elois, of the Tug Star, drowned in Saginaw River.
- Luke Sky, of the barge Hotchkiss, drowned at Buffalo.
- 19th.—Steamer Favorite damaged by collision at Detroit.
- Brig Helfenstein, salt, arrived at Detroit leaking.
- Schooners American Union, ore, and S. P. Ely, damaged by collision in a dense fog, at Port Huron.
- Scow Industry, walnut lumber, found water-logged and abandoned on Lake Erie; towed to Cleveland.
- 21st.—Scow Pierrepont and propeller Mohawk damaged by collision at Detroit.
- Tug J. H. Martin broke her machinery; towed into Detroit.
- 22d.—Bark C. K. Nims, 33,000 bushels corn, struck a reef at Bar Point, Lake Erie.
- Schooner Monterey struck a rock, and damaged.
- Schooner Middlesex sprung a leak at Marquette.
- Schooner Sophia Smith damaged by collision near Detroit.
- Steamer W. R. Clinton damaged on a rock at Grindstone City.
- 24th.—Propeller Cuba aground at Milwaukee.
- Schooner Welland ran against the pier at Muskegon, was crushed, filled with water, and capsized.
- Scow Snowbird injured and sunk, by a blast intended for the removal of rocks in the Detroit River.
- Mr. ——— McDonald drowned from the steamer W. R. Clinton on Lake Huron.
- Scow Maria sprung a leak on Lake Huron.
- 25th.—Propeller Bertachy burned at Depere, near Green Bay, loss \$8,000.
- Charles Hendrickson drowned from schooner Dayspring, at Ahnapee, Lake Michigan.
- Tug J. D. Dudley ashore at Fairport, Lake Erie.
- 26th.—Schooner David Stewart, ore, hard aground on the Saint Clair Flats.
- Schooner Narragansett lost canvas in a squall on Lake Erie.
- Schooner Columbia, coal, aground in Detroit River.
- A scow driven ashore on Lake Huron, near the entrance of the Saint Clair River.
- 27th.—Schooner Lewis Ludington lost jib-boom at Chicago.
- 28th.—A northeast storm on Lake Michigan to-day, driving many vessels into port for shelter.
- Scow Ida H. Bloom struck a pier at Milwaukee and lost jib-boom.
- Several small sail-boats lost or damaged at Milwaukee.
- A canal-boat sunk, and another damaged, in the Niagara River.
- Schooner Louie Meeker, 22,000 bushels of oats, struck by a squall at 10 a. m., ten miles from shore, near Point Sauble, Lake Michigan, capsized and sunk. Captain Robert West, Robert West, jr., Charles Baker, E. Nelson, and the steward were drowned.
- Schooner Glad Tidings lost jib-boom in the gale on Lake Michigan.
- Scow Minnie Corlette, shingles and piles, damaged at Waukegan.
- 29th.—Schooner Garibaldi had sail torn by a bridge at Milwaukee.
- Michael Neupert drowned from the tug Ballentine, at Bay City.
- Schooner Angeline lost mainsail in a squall.
- Schooner J. R. Sanburn split her mainsail and fore-topsail.
- Schooner Cortland had canvas blown away.
- Schooner Almira damaged on the piers at Cleveland.
- Scow J. W. Porter ashore at Clough's Pier.
- A raft of logs broke loose from a tug at Cleveland and washed ashore.
- 30th.—Barge El Dorado broke her steering gear, and was towed into Milwaukee.
- Brig Waucoma, iron, sprung a leak near the Manitous, Lake Michigan.
- Schooner Delos De Wolf, grain, sprung a leak on Lake Michigan.
- Schooner Sea Gem damaged at the pier at Maunitee.
- Tug Louie Dole damaged by collision with the tug Black Bell, off Chicago.
- Scow C. C. Butts sunk at Kenosha.
- Schooner G. J. Whitney, stone, ashore, and full of water, at Vermillion, Ohio.
- A number of vessels aground on the Saint Clair Flats, owing to the low stage of the water.
- Schooner Alpha, lumber, wrecked at 5 p. m. on a reef near Four-Mile Point, Lake Ontario.
- Schooner Orion sunk at Long Point, Lake Erie.

Schooner Richardson ashore at Presque Isle, Lake Erie.
 Propeller Buckeye broke her engine on Lake Ontario.
 Schooner Odd Fellow, lumber, lost mainsail and a portion of her cargo.
 A severe northwester on Lake Huron; vessels unable to proceed, anchored along the coast.
 Schooner Franconia, pig-iron, sprung a leak on Lake Huron.
 Scow J. F. Porter stranded on south shore of Lake Erie.
 Schooner Montauk and Bark Pathfinder lost jib-booms at Port Huron.
 Propeller Toledo had her gangways dashed in on Lake Huron.
 Schooner C. P. Minch aground at Port Huron.
 Scow Hannah lost jib-boom by collision, on entering the Saint Clair River.
 Schooner Governor damaged at the pier and grounded at Oswego.
 Schooner Two Brothers lost 16,000 feet of lumber on Lake Ontario.
 Schooner Olivia lost 6,000 feet of lumber on Lake Ontario.
 Revenue-cutter Chase lost anchor and chain on Lake Ontario.
 A seaman drowned from the Barge Toledo, at Kingston.
 Brig Ocean, stone, sunk in Lake Ontario.
 Schooner Vancouver, pig-iron, sprung a leak on Lake Ontario.
 31st.—Barks William Howe and Prince of Wales ashore near Port Dalhousie, Lake Erie.
 Schooner Fanny Campbell disabled near Point au Pellee.
 Bark Alexander, timber, sprung a leak off Long Point.
 Schooner Augustus Ford, coal, sprung a leak on Lake Erie.
 Schooner Erie sunk while at anchor at Marblehead, Lake Erie.
 Schooner Amoskeag struck in Sault Ste. Marie River, and sprung a leak.
 Schooner Eliza White damaged by fire at Oswego.
 Brig Gen. Worth lost foremast off the Scotch Bonnets.
 Barge Argo lost lumber and shingles overboard on Lake Ontario.
 Scow Ida and Mary, stone, ashore, at night, on Sturgeon Point, Lake Erie.
 Propeller City of Madison damaged and driven back to Marquette, Lake Superior, by the storm.

PAPER H.

METEOROLOGICAL OBSERVATIONS MADE AT MOUNT WASHINGTON, N. H.,
DURING THE MONTH OF MAY, 1872.

OFFICE OF THE CHIEF SIGNAL-OFFICER,
Washington, D. C., July 10, 1872.

SIR: I have the honor to submit the following report of meteorological observations made in compliance with your orders at Mount Washington, New Hampshire, from May 1 to May 31, 1872, during which time a special station, established at the railroad depot, near the base of the mountain, was in telegraphic communication with the permanent station at the summit.

Fifteen observations were made daily at both stations at hourly intervals, and especial pains taken to have them made synchronously. (Papers A and B.)

Instruments used at Summit Stations.—Barometer, Green's standard No. 1797; instrumental error,—.005; thermometer, Green's mercurial; hygrometer, (Glaisher's model;) anemometer, Robinson's; rain-gauge, signal-service model.

At base of mountain.—Barometer, Green's, No. 1914; instrumental error,—.002; thermometer, Green's; hygrometer, Glaisher's; anemometer, Robinson's, with Gibbon's self-registering attachment; rain-gauge, signal-service model.

Observers.—Summit station: Sergeant A. R. Thornett, signal-service, United States Army; Private R. J. Bell, signal service, United States Army. Lower station: Sergeant Theodore Smith, signal service, United States Army; Private J. H. Garrad, signal service, United States Army.

Attention is invited to the special report of Sergeant Smith, (Paper C,) and to the daily journals kept at both stations, (Papers D and E.)

Paper F exhibits, in tabulated form, the daily observations made at the mountain stations, and Paper G those made at Portland, Maine, for the same period of time, at an elevation of 54 feet above mean-tide level. Of the Portland observations, those made at 8.2 a. m., 5.2 p. m., and 12.2 a. m. are synchronous with those made on the mountain stations at 7.57 a. m., 4.57 p. m., and 11.57 p. m.

Very respectfully, your obedient servant,

H. W. HOWGATE,
*Second Lieutenant and Brevet Captain, United States Army,
 Acting Signal-Officer and Assistant.*

Brigadier-General ALBERT J. MYER,
Chief Signal-Officer of the Army.

afternoon, and looked hazy and threatening all around, but the clouds are still considerably higher than the summit of Mount Washington. Saw some butterflies to-day on the snow, which melts away very fast. Cleared away again about 5 o'clock p. m., leaving the sky covered with about one-fourth cirro-stratus clouds. Barometer, still high and steady; temperature, 42° at 9 o'clock p. m.

May 1.—Sky entirely overcast at day-break, looking very threatening. Barometer falling slowly until 9 o'clock a. m. Temperature rising rapidly. Commenced to clear up at 10 o'clock a. m. Wind southwest and gentle. Barometer continued to fall until 4 p. m., and the wind suddenly changed to southeast. Very black masses of nimbus clouds came moving from that direction, soon after enveloping the mountain down to the line of vegetation. The summits of Lafayette and the Twin Mountains are still uncovered, but the clouds are filling all of the valleys rapidly. At 8 p. m. barometer still falling; wind, due south and gentle. All the mountain-summits are now enveloped in clouds, reaching down below the line of vegetation. Observer at the summit reports, "Rain and wind southwest and sixty miles per hour." Very dark below; could not see objects at more than a few yards distance. Temperature remains almost unchanged since 8 a. m., being 50° at midnight. Appearances indicate heavy rain on the mountains, the little stream here rising very rapidly, and the rush of waters in the different ravines resounds from all sides.

May 2.—Commenced raining shortly after midnight, and continued quite hard at day-break. Wind still south, but veering at times to southeast. Barometer still falling slowly. Temperature steady. Humidity, 100 per cent.; the clouds moving very fast from the southwest and reaching far below this station, forming one large continuous sheet over the valley of the Amonoosuc. Rain ended at 9.45 a. m., and soon after the blue sky became visible in the west. The clouds in the valley and around the summits of the different mountains dissipated quite rapidly, and shortly after 10 a. m. the top of Mount Washington became clear. The telegraph line works very hard this morning, and no communication has been had with the summit since 12 m. of last night, when we adjusted our time-pieces. The rain has taken nearly all of the snow away from the mountain-sides, and the Amonoosuc River is higher than at any time during this spring. Wind changed to northwest after 12 m., and it commenced to cloud up again. Raised Mount Washington at 1 p. m. for barometer signal, and compared time. "Relayed" his morning report; he said that he had been unable to "break in" this a. m. Barometer showed tendency to rise again between 1 and 2 p. m., but temperature is falling slowly. Clouds again cover all the mountains and move very rapidly from due west, but some lower masses are moving from the southwest; between 3 and 4 p. m. all of the mountain-summits were clear of clouds, and the atmosphere generally was remarkably transparent. At 4.30 p. m. it commenced clouding up again. Temperature falling, but barometer rising. A heavy rain commenced at 5 p. m., the observer at the summit reporting, "Dense fog here." The observer at Mount Washington being unable to break Littleton, I relayed his p. m. report at 5.02 p. m. Rain ended at 5.30 p. m., but commenced again at night-fall, barometer and temperature falling with southerly winds. Relayed Mount Washington midnight report.

May 3.—Heavy rain during latter part of night, continuing until day-break. Temperature, 39°. It having snowed upon the mountains during the night, they present quite a wintry appearance this a. m. Weather still threatening. Shortly after 7 a. m. all of the mountains became enveloped in dense clouds. Barometer steady. From 7 a. m. until 4 p. m. we had rain, snow, and sleet, but rain prevailing, temperature ranging from 33° to 37°. Calm nearly all day; commenced clearing in the west shortly after 4 o'clock, the upper clouds (huge cumuli) moving at a moderate rate from the west, while the lower ones (below the summit) are moving very swiftly from due north. Perfectly calm at this station. Sky became almost clear at 6 p. m., and remained so until 11 p. m., when it clouded up again, wind being southeast and light. Temperature 32, and barometer rising slightly. Faint auras in the north.

May 4.—Threatening at day-break, and shortly before 7 a. m. heavy snow set in. Barometer steady. Temperature 35°; wind northwest and light. Observer at summit reported sleet at 10 a. m. and brisk southeaster. Continued snowing all day; between 2 and 3 p. m. the snow fell in flakes of an unusually large size, and by midnight nearly 6 inches covered the ground. Barometer rising since 6 p. m.; temperature steady.

May 5.—Clearing up rapidly at day-break, with very light westerly wind and rather low temperature. All of the mountain-summits were visible and had the appearance of midwinter. The temperature reached 38° before midday and the snow commenced to melt very rapidly. Littleton reported this a. m., "Heavy rain during night." The barometer reached its maximum between 1 and 2 p. m. Cloudy in the afternoon; wind northwest and fresh; temperature 41° at 6 p. m.; clouding up again shortly after 10 p. m. Mount Washington observer reported, "Temperature 18°; wind northwest and 96 miles." Barometer fell quite rapidly after midnight.

May 6.—Commenced snowing at 5 p. m.; temperature 30° and wind south; barometer low but steady; continued snowing until 12.30 p. m., when the clouds began to clear away, both upper and lower clouds moving very rapidly from the northeast. Barometer rising since 8 a. m.; temperature 42° at 3 p. m.; wind northeast and fresh. The summit of Mount

Washington is still enveloped in clouds. Wind changed to northwest at 4 p. m.; observed some cirri moving from the east, while the cumuli came from the north, and small detached masses of strata were going with the wind prevailing at this station. The snow is melting very rapidly, and the ground is bare on the south side of the houses. Barometer still rising slowly. Weather fair after sunset. Barometer steady at midnight.

May 7.—Day opened with fair weather. Barometer steady; wind northwest and light; thermometer 41° ; remarkably clear around the western horizon. Mount Lafayette and the entire Franconia range clear, but Mount Washington enveloped in dense clouds, reaching down far below the line of vegetation. The summit became clear at 1.30 p. m., but the sky remained overcast with large masses of cumuli. Barometer steady in afternoon. Thermometer 56° at 3 p. m. Observer at summit reports: "Wind north, with heavy gale; temperature 37° ; barometer 30.09, with tendency to rise." The snow upon the west side of Mount Washington seems to melt but very slowly. Between 5 and 6 p. m. the thermometer reached 62° ; perfectly clear all around after 6 p. m., barometer rising, wind east and light. Wind changed to north toward midnight. Weather clear and pleasant.

May 8.—Cloudy at day-break, with easterly wind, but cleared away before 8 a. m., wind changing to northwest. Barometer steady; temperature 49° . Summit of Mount Washington remained enveloped in clouds after the sky had become perfectly clear. Summit clear at 12.30 p. m. Barometer steady; temperature rising; 60° at 2 p. m.; humidity 49 per cent. Hazy along the different mountain-ranges, probably caused by evaporation, as large masses of snow still remain in the woods. Sky overcast with cirri after 3 p. m., moving in a southerly direction; barometer rising until 8 p. m., when it began to fall slowly. Observer at summit reports: "Fine weather all day; highest temperature 40° ." Private Bell, who came down from the summit this p. m., reports there is hardly any snow at the summit, but that he found it from 4 to 6 feet deep near the line of vegetation, and also large masses throughout the woods. No change in the weather until shortly before midnight, when the wind changed to due east and the sky became overcast.

May 9.—Commenced raining about 2 a. m., and rained quite heavy at day-break; barometer fell somewhat during the night, but the temperature is steady; began to clear up at 8.30 a. m., and wind changed to northwest. Thermometer 63° at midday, the warmest day we have had so far. Franconia Mountains clear, but Mount Washington still enveloped. Observer at summit reports: "Thermometer 39° at 10 a. m." Weather remained cloudy all day. Barometer fell very rapidly until 6 p. m. Temperature 65° at 4 p. m. Very hazy during the afternoon, and only the outlines of the different mountains could be distinguished. Commenced clearing up at 7 p. m., the sky becoming perfectly clear. The wind increased somewhat toward midnight, being from the northwest. Temperature 50° all night.

May 10.—Day opened with warm and fair weather. Barometer rising; remarkably clear in the west. Detached masses of stratus clouds were moving with an extraordinary rapidity from the northwest, being of a whitish color before reaching Mount Washington, and then assuming a dark black color; they envelop almost the entire mountain, and it seems to be raining very hard there, for the Amonosuc is rising rapidly. Mount Lafayette, only eighteen miles distant, is clear to the very top, forming quite a contrast to the Mount Washington range. Telegraph line to the summit works very hard, and I had to relay the Mount Washington signals. Barometer continued rising very rapidly, and between 2 and 3 p. m. the summit of Mount Washington became visible. Temperature steady. Barometer still rising at 9 p. m., being now 40° higher than at 6 o'clock this a. m. Sky perfectly clear, excepting a small bank of strata along the western horizon. The mountains now are entirely free of snow. Temperature quite low this evening; clouding up after 10 p. m. Barometer steady.

May 11.—Barometer fell but slightly during night. Sky overcast this morning and Mount Washington in dense clouds. Lafayette and Twin Mountains clear. Barometer pretty steady all day, with warm and pleasant weather generally. Much free electricity on the wires during the afternoon. Hazy after dark. Humidity 92 per cent. at 9 p. m. Sky perfectly clear.

May 12.—Barometer fell very rapidly during the night, and at day-break the sky was entirely overcast. Wind east, but changed to northwest before 9 a. m. Barometer steady until 8 p. m.; perfectly clear at midnight.

May 13.—Clear at day-break; temperature 39° , and humidity 100 per cent. Barometer steady. Commenced clouding up at 9 a. m., and now, 11 a. m., it looks rather threatening. The summit, which was clear this morning, is enveloped in dense clouds, apparently moving from the south. Barometer rising slowly during the day, and after sunset the clouds cleared away. Temperature falling rapidly during the afternoon, and the humidity increases. The telegraph line has worked very well for the past three days. Barometer rising rapidly after 6 p. m.

May 14.—Day opened with cool and fair weather. Barometer still rising. Wind northwest, and gentle. Weather remained unchanged, excepting a rise in the temperature, until sunset; clear at midnight. Barometer very high.

May 15.—Hazy at day-break. Wind east and light; considerable ice was formed during the night. Temperature 39° at 6 a. m., and barometer very high. Wind changed to northwest after 8 o'clock and clouded up, but the clouds are far above the different mountain summits. Trouble on the telegraph line between here and Littleton; divided here and re-

layed Mount Washington signals. Barometer commenced falling shortly after 10 a. m., and the sky began to assume a threatening aspect. Heavy masses of nimbus clouds moving from the north soon enveloped the summit, and the observer there reported snow at 3.30 p. m. A light shower, of short duration, set in at 3.10 p. m.; appeared to be raining very hard a few miles west of this station. Cleared up again at 4.30 p. m., but another shower from the north passed this station between 7 and 8 p. m. Clear, with easterly wind and steady barometer, until midnight. Temperature 34°, and falling.

May 16.—Very cold during night and at day-break. The wind changed to west between 8 and 9 a. m. Barometer falling. Brisk northerly and northwesterly winds during the day. Clouding up gradually after 2 p. m. Appearances very threatening at 4 p. m. Temperature 40°. Barometer still falling; no change during the evening.

May 17.—Day opened with threatening weather. Barometer rising; temperature steady since yesterday morning. Wind west and light. Mount Washington entirely enveloped in clouds, but Franconia range and summit of Mount Lafayette clear. Fair in the afternoon; temperature 51° at 1 p. m. Barometer still rising steadily. After a calm of a few hours' duration the wind began to blow from the east; at 9 p. m. the sky was perfectly clear, but began to cloud up again between 10 and 11 p. m. Mount Washington observer reported snow this a. m., and very low temperature; the effect of which was felt here, for although the sun shone brightly during the afternoon, the air was very chilly. Weather clear at midnight.

May 18.—Day opened with clear and cold weather. Barometer steady; wind east, but changed to west shortly after 8 a. m. Temperature rising very rapidly, reaching 61° at 4 p. m. Barometer falling very slowly since 9 a. m. Wind veered again to east between 7 and 8 p. m. Dense haze around the different mountain ranges at 9 p. m. Sky perfectly clear. No change till midnight.

May 19.—Very hazy at day-break; the haze increasing in density as the morning advanced until 11 a. m., when large cumuli commenced to form. Barometer quite low this morning and still falling. Temperature 59° before midday. Wind from east, veering at times to southeast. Very heavy masses of cumuli came moving from the southeast after 1 p. m., and 1.55 p. m. rain set in. The wind shortly after increased to brisk. Barometer very low and still falling. Observer at summit reported, "rain; wind south but variable." Telegraph line works very hard; divided and relayed Mount Washington reports; unable to raise Mount Washington for p. m. reports; raining hard. Concord reports, "Heavy rain most of the day." The clouds broke away for a short time between 9 and 10 p. m., but rained very hard all night; nearly an inch fell since yesterday morning.

May 20.—Raining very hard at day-break. Barometer stands lower than at any time since this station has been opened. Nearly calm since midnight, but commenced to blow again between 6 and 7 a. m.; the wind now being west. Temperature steady since yesterday morning, having fallen only 2° during last night. Impossible to raise Mount Washington for signals, but wire works well between here and Boston. Mount Washington appears unable to break us on account of the bad condition of the cable; called him for two hours this morning, but without success. Ceased raining at 10.50 a. m., and commenced clearing shortly afterward. The different mountain summits covered with snow. Barometer seems to have reached its minimum, (10 a. m.) Just raised Mount Washington, and relayed all of the delayed reports and gave him the time. Quite pleasant during the afternoon, but barometer remained low and steady. Clouded up at 7 p. m., and has been raining ever since.

May 21.—Raining hard at day-break; wind west and light. Barometer rising. The clouds are very low this morning, enveloping the station completely. Temperature steady. I relayed Mount Washington reports again this morning. Commenced to clear up at 10.30 a. m., but clouded up again between 12 and 1 p. m. A very heavy shower set in shortly after 2 p. m., barometer rising rapidly all day. Wind changed to east at 8 p. m. Weather fair. Humidity 100 per cent. Temperature fell rapidly during the evening. Fair at midnight. Wind north. Barometer still rising.

May 22.—Day opened with cool and fair weather; ice being formed during the night. Barometer rising until 11.30 a. m.; falling steadily during the afternoon. Sky remained overcast nearly all day. Between 5 and 6 p. m. I observed a peculiar phenomenon, (which I frequently beheld at the summit during the winter of 1870-'71, while in charge of that station,) consisting of heavy masses of cumuli moving from the south and southeast toward the Mount Washington range, from the summit westward to Mount Pleasant; but, on reaching the ridge of this range, they suddenly dissolve, only small detached masses passing over to the north side, but they also dissolve soon afterward. Temperature steady all day. Humidity variable. Threatening at midnight.

May 23.—A severe rain-storm, accompanied by a brisk southeasterly wind, set in about 1 a. m.; for a time the rain came down in torrents, and after 3 a. m. the wind increased so high. The rain abated somewhat about this time, but the wind kept up a velocity of 20 miles an hour until 10 a. m. Barometer falling rapidly all night. Temperature steady. Showed signs of clearing after 11 p. m., but a drizzling rain still prevails. The cable to the summit works very hard. Relayed Mount Washington morning reports, but could not raise him after that time. Concord and Littleton both report rain. Wire working hard south of

this station. Lieutenant Greely reached the summit at 6 o'clock last evening, by way of the old carriage road. Threatening after 12 m., and at 3 p. m. the wind veered to the west. Another shower of short duration set in between 3 and 4 p. m. Barometer commenced to rise at 7 p. m., and after dark a dense fog prevailed. No change in the weather at midnight.

May 24.—Heavy shower at 4 a. m., and drizzling rain after 6 a. m. Concord reported clear weather this morning, saying, "Not a cloud to be seen here." Barometer and temperature steady. Wind west and light; nearly calm since 1 p. m. of yesterday. Fair during the afternoon; temperature 61° at 4 p. m. No change in the weather at midnight.

May 25.—Cloudy and threatening at day-break; temperature unusually high; barometer falling, wind west and light. Humidity very high. Cleared up toward evening; temperature 64° at 5 p. m.; clear at midnight, with rising barometer.

May 26.—Day opened with threatening weather. Very cold during night. Barometer rising rapidly after 6 a. m.; clearing up at 9 a. m. Sky became overcast again between 3 and 4 p. m., with cirri, which formed quite rapidly, but disappeared again after dark.

May 27.—Clear at day-break. Barometer falling slightly; temperature high; wind south-east. Commenced to cloud up after 1 p. m., the wind being due east and increasing in velocity. Barometer still falling. Appearances very threatening at 6 p. m., and the peculiar haze which always precedes rain in this section of the country commenced to form around the mountains, threatening rain at midnight. Barometer falling rapidly.

May 28.—Rain set in about 2 a. m., and rained quite hard for a time; drizzling after day-break. Barometer very low. Mount Washington is once more covered with snow. Wind changed to west about 9 a. m., and the clouds began to break away. Showers at intervals during the day. Barometer rising after midday. Cable to the summit works very hard, and I divided and relayed Mount Washington signals. A very heavy rain set in at 6.30 p. m. Mount Washington reports snow.

May 29.—Raining very hard all night, especially toward day-break. Barometer rising rapidly, and at 5 a. m. the rain ceased; began to clear up at 6.30 a. m., and the mountains are perfectly covered with a thick coat of snow, reaching down close to this station. Thermometer only 40° at 6 a. m. Heavy showers during the day. The cable working extremely hard at 2 p. m. Concord wire failed also, but commenced working again shortly after 6 p. m. Clear westward after dark, but Mount Washington is still enveloped in dense clouds. Barometer rising all day. Temperature varied only 2° the entire day. No change in the state of the weather at midnight. Unable to raise Mount Washington for signals.

May 30.—Threatening at day-break, with high barometer and low temperature. Showed signs of clearing in the west; and at 8 a. m. the clouds began to break away, moving from the northwest, while an easterly wind prevailed at this station. Could not raise Mount Washington until 8 a. m., when I relayed his reports. Concord wire works well. Clouded up again after 2 p. m., and commenced raining at 4 p. m. Threatening at midnight.

May 31.—A very heavy rain set in about 1 p. m., lasting all night. Barometer falling rapidly; temperature steady. Nearly calm ever since 12 m. of yesterday. Unable to raise Mount Washington this morning, although we used Concord and Littleton batteries. Received his morning reports at 11 a. m., after much trouble. Wire south of here works well. Continued raining until 3.45 p. m., but commenced again at 5.30 p. m. Barometer rising since 6 p. m.; temperature steady. Still raining at midnight. Nearly calm all day.

Instruments in excellent condition during the entire month. During the first two days that the instruments were in position I observed a difference, ranging from 2° to 6° , between the standard thermometer and the dry bulb of the hygrometer, although the instruments were exposed under precisely the same condition. I changed the position of the standard frequently, but without success. I then cut a circular opening (diameter three inches) in the lower part of the hygrometer-board, the center of the opening being about at the height of the bulbs, thus creating a free circulation of the air around the same; and my experiment proved a success, as the two dry bulbs read alike. As similar differences are reported from quite a number of our stations, it is believed that the above might be applied with equal advantage.

THEODORE SMITH,

Observer-Sergeant, Signal Service, United States Army.

BASE OF MOUNT WASHINGTON, N. H., June 1, 1872.

Paper E.

EXTRACTS FROM DAILY JOURNAL FOR THE MONTH ENDING MAY 31, 1872.

May 1.—The barometer fell very steadily throughout the day. The thermometer fluctuated slightly, ranging between 37° and 42° . Humidity 58 to 100 per cent. Wind from the west until noon, when it changed to southwest, veering between that point and south the rest of the day; velocity steady, at from forty to fifty miles per hour, the maximum being sixty-six

miles per hour at 9 p. m. The weather was very doubtful in the early day and afternoon, the clouds changing their formation very often, but always moving with the wind. They were principally ill-defined cirro-stratus and cirro-cumulus clouds, blended in all sorts of shapes. The glens and ravines were filled with dense haze until 2.30 p. m., when a change took place; the summit of the mountain became completely shrouded in a heavy, saturating fog, which turned to rain at 7 p. m. ending at 9.30 p. m., with about .02 rain-fall. After 9 p. m. the weather continued threatening, the wind blowing sixty-five miles per hour from the south.

May 2.—The barometer fell gradually, and oscillated a little during the day. The thermometer steady at from 36° to 38° until night-fall, when it fell to 32° . Wind ranging between west and south, with a velocity of from thirty to sixty miles per hour, falling off to gentle wind at midnight. The weather was very unsettled throughout the twenty-four hours, raining and hailing in a drizzle at intervals, turning to sleet at times. At 10 a. m. the sky partially cleared, and the atmosphere became very transparent for a few minutes. The glens and surrounding ravines were full of large cumulus clouds, which in a short time surrounded the summit and formed dense fog, which hung over us until late at night. At midnight the sky was covered with well-defined stratus clouds. The hail that fell came down in very fine stones, turning to drizzling rain. My morning report was delayed, in consequence of not being able to break Sergeant Smith or Littleton, who called me repeatedly and distinctly, but were not able to get my answer to the call. I succeeded in raising Sergeant Smith at 1.20 p. m., who then took the report and forwarded it.

May 3.—The barometer still falling; total fall through the day, .10. The thermometer steady, fluctuating between 28° and 31° , falling rapidly after night-fall, to 23° at midnight; the wind blowing steadily from south to southwest, with a velocity from fresh to high wind. The weather has been very unsettled, constantly changing from light snow to sleet, drizzling rain, and dense fog; at intervals making feeble attempts to clear, but always failing to do so. After 8 p. m. the sky partially cleared, but remained half covered with stratus clouds; the stars shining brightly through the spaces. A little before 9 p. m. I noticed a brilliant sheet of pale yellow light in the northern horizon, partially obscured by a heavy clump of stratus clouds; this "aurora" remained stationary until after midnight, but steadily diminished in intensity.

May 4.—The barometer showed a steady decrease of pressure in the early part of the day, rising at night a little higher than the morning maximum. The thermometer steady, ranging between 21° and 24° ; very steady nearly all day at 22° and 23° . The wind fluctuated between north and south from the eastern points, with brisk and high wind until after 8 p. m., when it increased to hurricane velocity of from ninety to one hundred miles per hour. The day opened with threatening weather, changing to snow and sleet, settling down to a heavy fall of snow throughout the day.

May 5.—The barometer fell steadily all day, and rapidly after 8 p. m. to midnight. The thermometer ranged between 15° and 22° . The wind steady from the north, with brisk and high velocity, veering to northwest and turning to hurricane at night-fall. The weather, during the hours of daylight, gave a prospect of clearing, the sun going down clear and red, and that portion of the sky not covered with stratus clouds being entirely clear. This changed to threatening weather after 9 p. m., the clouds massing round the summit very thickly, so as to obscure all surrounding objects from view. A slight fall of snow after midnight; no measurement.

May 6.—The barometer showed a steady increase of pressure, rising rapidly after sundown. The thermometer rose steadily, and gave higher endings than on yesterday, (23° to 27° .) The wind blew steadily from the north, with brisk velocity up to night-fall, rising to gale and afterward to storm. The weather was very unsettled all day, snowing lightly at intervals, clearing partially at 2 p. m., becoming overcast shortly after, and set in threatening the rest of the day.

May 7.—The barometer rose steadily all day. The thermometer rose steadily, and gave a maximum of 39° . The wind changed from north to west at 2 p. m., and settled afterward from northwest. The day opened with drizzling rain and a storm-velocity of wind, then turned to fog after 8 a. m., remaining so until 2 p. m., when there were evident signs of clearing weather; turning fair shortly afterward, and remaining so throughout the rest of the day and night. The wind turned to high, and (gradually) to brisk at night. Upper clouds moved from the northwest.

May 8.—The barometer still rising steadily, with a slight rise in the temperature. The wind from the northwest, and of brisk and high velocity, blowing at very uniform rates. The weather opened and remained fair all day until evening approached, when the sky became gradually obscured by stratus and cirro-stratus clouds, which turned to nimbus and rain at 2 a. m. the following day, (9th instant.)

May 9.—The barometer fell steadily all day, and rapidly after sundown. The thermometer gave a steady increase of temperature, rising to 47° . The wind steady from the west, with an exceptional puff from the southwest. The velocity of "high" and "gale" rose rapidly after sundown to a violent hurricane, fairly staggering the building at times, coming in tremendous gusts. The day set in with a miserable drizzling rain, stopping at 2.30 a. m., turning into very cloudy weather until evening, when the stars and young moon shone out

brightly, but became obscured at 11 p. m., from which hour the sky was nearly covered with stratus clouds. A slight margin of clear sky remained near the eastern horizon.

May 10.—The barometer rose rapidly all day. (I made a report at midday of .16 rise.) The thermometer fell rapidly in the early morning, steady through the day at 31° , rising a little at night. The wind steady from the west, decreasing gradually from hurricane to high velocity. The day began with rain, which held up after 8.40 a. m. Cloudy weather from that hour up to 1.30 p. m., when the sky cleared rapidly, and fair weather prevailed until 11 p. m., when the stars and moon were nearly obscured by about three-quarters stratus clouds. After 11 p. m. the barometer remained very steady.

May 11.—The barometer changed very little until midday: after that time it fell slightly and steadily. The thermometer rose steadily all day. The wind blew from the west all day with gale velocity up to night-fall, and then increased to a storm from the same quarter; sky clear. The weather was very cloudy until after midday, then cleared rapidly, and at 9 p. m. and after the sky was quite free from cloud, the stars and moon being very clear and bright. During the afternoon the chief part of the clouds were below the summit.

May 12.—The barometer and thermometer steady; wind from the west and northwest, gradually falling off in velocity and settling down to a fresh breeze. The weather fair during the day, becoming perfectly clear after night-fall. At midnight I noticed a few faint shooting-stars crossing the western horizon in close proximity to the moon. Earlier a halo encircled the moon; it was of very narrow diameter.

May 13.—The barometer rose steadily all day, but not enough to denote any particular change in the pressure. The thermometer fell evenly, dropping to 26° at midnight. The wind fluctuated between west and northwest, settling steadily from the north after sundown. The velocity was steady all day, alternating between fresh and brisk wind, except in the early morning, at which time it was nearly calm. The weather was quite fair, except during the latter part of the forenoon, when the summit was covered with dense clouds, rising from the ravines. The clouds were principally well-defined cirrus, mixing at times with cumulus, forming cirro-cumulus.

May 14.—The barometer continued rising all last night and to-day. The thermometer rose gradually until 4 p. m., when it attained a maximum temperature, for the day, of 34° , remaining steady at that height until after 6 p. m., when it began to fall steadily. The wind has fluctuated between the points north and west, with a velocity fluctuating between fresh and high wind. The weather has been very fair and bracing; the lower atmosphere comparatively clear. Principal clouds cirro-cumulus, with here and there well-defined cirrus and cumulus; very little stratus.

May 15.—The barometer fell steadily all day. The thermometer very steady, falling a little toward night-fall. The wind settling from the north; after sundown, rising to a strong gale. During the day the wind fluctuated between north and west. The weather during the early forenoon and afternoon was very cloudy, turning to light flurries of snow at intervals. The sky became almost free from clouds after 9 p. m.; only a slight streak of cirro-stratus remained hanging on the horizon at midnight.

May 16.—The barometer fell slightly during the day, going up slowly after dark. The thermometer fell rapidly last night and this morning, going down to 15° ; rose slightly through the day, and remained nearly stationary at 22° after night set in. The wind blew a hard gale from the north nearly all day, the direction veering to west, and intermediate points between west and north. The weather was fair in the morning and forenoon, turning to cloudy weather after 1 p. m., and remained so the rest of the day.

May 17.—The barometer indicated a gradual increase of pressure throughout the day. The thermometer rose 8° higher than yesterday. The direction of the wind changed continually all day between the points of northeast and northwest; the velocity brisk all day, with a slight falling off to gentle wind in the afternoon. The morning opened with light snow, which had been falling some hours during the night. This changed to cloudy weather up to 10 a. m., when the weather became very fair, and the atmosphere transparent enough to allow of seeing the Atlantic Ocean and the surrounding country. The night set in clear, the moon and stars coming out with unusual brightness.

May 18.—This day has been almost a duplicate of yesterday. The barometer remained almost stationary until after 8 p. m., when it began to fall slightly. The thermometer rose steadily, reaching a maximum of 41° . The direction of the wind changed frequently from northeast to northwest, and sometimes died out entirely; the velocity gentle to fresh, rising to brisk wind at night. Clouds nearly all well-defined cumulus, changing to cirrus after the moon rose. The atmosphere was not quite so transparent as on yesterday, but the view of the surrounding country was very fine and extensive.

May 19.—The barometer fell rapidly all day. The thermometer nearly steady, rising to 44° . The wind changed direction, blowing from all points of the compass in five minutes' space, making it very difficult to determine the true direction. The velocity rose to a heavy gale, and blew principally from the southeast and southwest. The weather was fair until about 11 a. m., when the summit became completely shrouded with dense stratus clouds; turned to heavy rain at 1.30 p. m., which continues falling the entire day and night, keeping on after the midnight observation was taken. Owing to the heavy wind, a very imperfect measurement of rain-fall was taken. The rain-storm to-day affected the telegraph communi-

cation very much, cutting it entirely off after 4.30 p. m.; up to that time I could communicate with the base (Sergeant Smith) and Littleton. I could hear Boston and Littleton call me repeatedly, and answer promptly; but from the bad working of the line was unable to break in, or make them understand me. In consequence, to-day's p. m. and midnight reports have been unavoidably held over. No electrical phenomena accompanied the storm to-day. The roof of the building is letting in water by the gallon, and we feel damp.

May 20.—The barometer continued falling until after 5 p. m., when it began to rise slightly. The barometer was very even throughout the day, fluctuating between 34° and 37° . The wind came from the southeast and southwest in the morning, changing direction to northwest at 9 a. m., blowing steadily from that point the remainder of the day, with a heavy gale velocity, falling a little after 9 p. m. The rain continued falling all last night and throughout the day with very little intermission, the water streaming into our habitation like "all possessed," and it was with great difficulty that we succeeded in keeping the books and stationery from destruction. At 2.15 p. m. the weather showed signs of clearing up a little; the sun broke through a chink in the stratus clouds and a few cumulus formed; this lasted until a few minutes past 6 p. m., when it rained and sleeted until 10.30 p. m. The weather, from that hour until after sending the midnight report, was threatening; changed to rain again in the early morning, and continues falling heavily. I had much trouble in getting off my midnight report, through the bad working of the line, and would have failed in doing so had not Sergeant Smith received it at the base and forwarded it to Boston for me. As it was, it required upward of twenty minutes' close application to send it through correctly.

May 21.—The barometer rose rapidly all day. The thermometer comparatively steady at 34° , falling to 29° after 11 p. m. The wind steady from the northwest, with decreasing velocity, going down to a fresh breeze at midnight. The rain and sleet continued almost incessantly until 5.50 p. m., when it cleared rapidly; and in half an hour from that time the sky was half covered with a mixture of cirrus and cumulus clouds. At midnight it was nearly clear weather, only a few light cirrus clouds dotting the blue canopy above. The moon and stars were very brilliant. From 9 to 10 p. m., however, a haze obscured the moon partially, and it was surrounded by a broadly marked halo.

May 22.—The barometer steady all day, falling rather rapidly toward night-fall. Thermometer steady. The direction of the wind changed to all points of the compass, with gentle and fresh velocity, rising to a gale from the south at night. Weather fair until night set in, when it turned very cloudy and threatening. Lieutenant Greely arrived here to-day at 5.50 p. m., and consumed the rest of the day in making his inspection of the station.

May 23.—The barometer continued falling all last night, and remained comparatively steady to-day, with an occasional rise or fall, varying from .01 to .03. The thermometer showed an increase in temperature, and oscillated at times to the extent of 3° between the hourly observations. The wind from the west and southwest, in the morning, with heavy gale velocity, changing to west and northwest after 2 p. m., the velocity falling off to brisk wind. The day opened with rain, which had commenced during the night, and, with slight intermission, continued falling all day. Lieutenant Greely departed at 2 p. m., after finishing his inspection and making a list of articles considered necessary for use on this station.

May 24.—The barometer rose in the early morning a little and remained very steady through the middle of the day, falling gradually after 8 p. m. The thermometer rose to 48° , the highest recorded temperature here this year. The wind from the northwest and west, with gentle and fresh velocity, rising to a gale at night. At 10 a. m. it was dead calm for about thirty minutes. Clouds in dense masses rose from the glens all day, making what might have been a very fair day, very cloudy at times. Stratus clouds on the summit formed about 3 p. m., and continued so the rest of the day and night.

May 25.—The barometer fell steadily all day, more rapidly after 9 p. m. The thermometer very steady through the day up to 5 p. m. at 43° , then it fell very rapidly, reaching a minimum of 31° at midnight. The wind came steadily from the west, with a high wind and gale velocity; changed to northwest after 6 p. m., and the velocity gradually increased until at midnight it blew a storm. The morning opened with light rain, which had been falling through the latter hours of the night, but stopped at 7 a. m. From that hour until early afternoon the weather was of a very cloudy nature. About 3 p. m. it began clearing rapidly, and at 6 p. m. the sky was about one-half covered with cumulus clouds, changing in another hour to very clearly defined cirrus clouds. From 9 p. m. there appeared a few stratus clouds high up, the cirrus clouds disappeared, and a dense haze obscured the brightness of the stars; this weather continued until midnight and after, the thermometer still falling, and everything below the summit free from haze or cloud.

NOTE.—At 7 p. m., while the wind blew from the northwest, the upper clouds were being driven rapidly from the southwest.

May 26.—The barometer rose very steadily all day, and I forwarded a midday telegram showing an increased height of .17 between the hours of 8 a. m. and 12 m. The maximum height of the barometer was given at 9 p. m., falling gradually from that hour. The thermometer fell last night to 28° , rising gradually from 7 a. m. to 40° in the late afternoon. The day opened with a heavy gale from the northwest, which subsided gradually, and is

heavy gusts, to a fresh breeze in the evening, changing direction at intervals to north. The weather was very fine and almost clear nearly all day. Nothing extraordinary took place to require recording.

May 27.—The barometer fell steadily all day, with a slight exception at midday, when it rose a little. The thermometer rose up to 11 a. m., standing steady from that time until 1 p. m., at 43°; it was 44° at 2 p. m., and fell steadily afterward. The prevailing wind came from the south and southwest, with high wind and gale velocity. At 4.50 p. m. the wind changed very abruptly, and without any decrease of velocity, to the southeast, blowing from that point about thirty minutes. The weather was fair until 3 p. m., when dense stratus clouds covered the summit and remained there until rain began falling at 11 p. m. This weather continued into the night.

May 28.—The barometer fell a little in the early forenoon, rising afterward steadily. The thermometer fell last night, and through the day showed a decrease of about 10°. The wind prevailed from the west, changing a few points at times north and south, with brisk and high velocity. The weather was very bad all day. Snow fell during the night and continued up to 10.30 a. m., changing then to rain and sleet; there was a slight cessation, of rain and snow at times, but there was no indication of clearing up.

May 29.—Barometer still going up, and the thermometer falling a few degrees. The wind from the northwest, with high and gale velocity. The rain of last night changed to snow, which continued falling until a little before day-break, and some of the drifts measured upward of 15 inches in depth. The mountain, above "Jacob's Ladder," was covered with snow, excepting where the wind had cleared the points of rocks. Heavy stratus clouds obscured the sky and covered the summit all day.

May 30.—The barometer rose steadily until 11 a. m., falling steadily afterward. The thermometer showed a slight increase of temperature. The wind came from all points of the compass, decreasing from gale in the morning to fresh velocity in the middle of the day, rising to brisk wind at night. The forenoon and afternoon were very cloudy, most of the clouds settling below the summit until evening set in, then the summit became covered with dense stratus clouds which turned to heavy driving rain at 6.40 p. m., and continued thus after midnight report was sent. I had unusual difficulty in telegraphing my midnight report to Boston, although a strong current was put on, as the bad weather caused frequent breaks.

May 31.—The barometer continued falling all through last night and to-day, rising slightly toward night. The thermometer has been very steady at 32° and 34°, dropping to 31° at night. The wind has blown from all the points of the compass with brisk and high velocity; it chopped very suddenly, between 9 and 10 a. m., from southwest to due east, and back to southwest; the direction of the wind was very uncertain, and changed many times during the twenty-four hours. The weather has been one continuous round of snow, hail, sleet, and rain all day.

Instruments, &c.—In addition to the instruments previously reported by me as being out of order, I have the honor to name the following: One cup blew off the anemometer on the 16th instant, during a heavy gale, and was lost down "Tuckerman's Ravine." I supplied its place by putting on a cup taken from the other instrument, which had been reported out of order. Also, one min. thermometer, slightly out of order.

I am, sir, very respectfully, your obedient servant,

ALFRED R. THORNETT,

Observer-Sergeant, Signal Service, United States Army.

SUMMIT OF MOUNT WASHINGTON, N. H., June 1, 1872.

Paper F.—(Form 4.)

Meteorological record for May 1, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM.		HYGROM.	WIND.	LOWER CLOUDS.		UPPER CLOUDS.		RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.							
			Attached.	Exposed.			Dry bulb.	Wet bulb.	Direction.	Velocity per hour.	Pressure per sq. ft.	Daily ve- locity.				Kind.	Amount.	Kind.	Amount.	Direction (moving from—)	Commen- d.	Ended.
Summit	6.00 a. m.	32.999	57	37	36	36	90	W.	42	8.82		Stratus...	2.4	Cirro-strat.	6.4	W.					Dense haze below. Threatening.	
Base...		37.34	48	42	40	38	80	S.W.	33	5.44		Stratus...	4.4	Hidden							Dense haze below. Threatening.	
Summit	7.00 a. m.	32.981	57	37	37	37	80	W.	33	5.44		Stratus...	2.4	Cirro-strat.	1.4	W.					Dense haze below. Threatening.	
Base...		37.32	48	46	47	42	39	81	S.W.	4	4.08		Stratus...	1.4	Hidden							Dense haze below. Threatening.
Summit	7.57 a. m.	32.981	58	39	39	37	81	W.	30	4.50		Stratus...	1.4	Cirro-strat.	2.4	W.					Dense haze below. Threatening.	
Base...		37.31	47	49	49	43	37	81	S.W.	1	1.01		Stratus...	1.4	Hidden							Dense haze below. Threatening.
Summit	9.00 a. m.	32.972	58	42	42	42	37	81	W.	48	11.52		Stratus...	1.4	Cirrus...	1.4	W.					Cloudy.
Base...		37.31	48	51	45	39	38	81	Calm.			Clear...	0	Cirrus...	3.4	W.					Dense haze below. Threatening.	
Summit	10.00 a. m.	32.959	58	42	42	37	58	W.	42	8.82		Dense haze	0	Cumulus	2.4	W.					Cloudy.	
Base...		37.31	49	50	45	39	64	S.W.	30	4.50		Dense haze	0	Cirrus...	3.4	W.					Dense haze below. Threatening.	
Summit	11.00 a. m.	32.961	58	40	40	36	64	W.	30	4.50		Dense haze	0	Cirrus...	3.4	W.					Cloudy.	
Base...		37.31	51	53	47	41	61	S.W.	6	1.18		Clear...	0	Cirrus...	3.4	W.					Dense haze below. Threatening.	
Summit	12.00 m.	32.958	59	41	41	37	65	S.W.	42	8.82		Dense haze	0	Cirrus...	3.4	S.W.					Cloudy.	
Base...		37.31	53	55	48	38	56	S.W.	8	3.32		Clear...	0	Cirrus...	3.4	S.W.					Dense haze below. Threatening.	
Summit	1.00 p. m.	32.940	60	42	42	38	56	S.W.	28	3.92		Dense haze	0	Cirrus...	3.4	S.W.					Cloudy.	
Base...		37.30	55	54	48	38	56	S.W.	6	1.18		Clear...	0	Cirrus...	3.4	S.W.					Dense haze below. Threatening.	
Summit	2.00 p. m.	32.939	64	42	42	37	58	S.W.	36	6.48		Hazy	2.4	Cirro-strat.	2.4	S.W.					Cloudy.	
Base...		37.28	54	54	55	49	38	82	W.	10	5.50	93	Stratus...	2.4	Hidden	1.4	0				Threatening.	
Summit	3.00 p. m.	32.930	71	40	40	38	82	S.W.	42	8.82		Dense fog	4.4	Hidden							Dense fog around summit. Threatening.	
Base...		37.29	55	53	49	37	73	W.	10	5.50		Stratus...	4.4	Hidden							Dense fog around summit. Threatening.	
Summit	4.00 p. m.	32.919	75	38	38	37	90	S.W.	48	11.52		Dense fog	4.4	Hidden							Threatening.	
Base...		37.29	54	50	51	48	79	S.W.	9	4.40		Stratus...	4.4	Hidden							Dense fog around summit. and very saturating.	
Summit	4.57 p. m.	32.917	77	39	39	38	91	S.	6	1.18		Dense fog	4.4	Hidden							Threatening.	
Base...		37.17	54	49	47	42	72	S.	6	1.18		Stratus...	4.4	Hidden							Dense fog around summit. and very saturating.	
Summit	6.00 p. m.	32.912	82	39	39	38	91	S.W.	50	12.50		Dense fog	4.4	Hidden							Threatening.	
Base...		37.26	49	50	50	47	79	S.E.	6	1.18		Nimbus...	4.4	Hidden				7.00 p. m.			Threatening.	
Summit	9.00 p. m.	32.854	73	39	39	39	100	S.W.	66	21.78		Nimbus...	4.4	Hidden							Threatening.	
Base...		37.26	54	47	49	47	86	S.	4	0.08		Nimbus...	4.4	Hidden							Threatening.	
Summit	11.57 p. m.	32.84	66	38	36	36	100	S.	63	21.12		Stratus...	4.4	Hidden					9.40 p. m.			Threatening.
Base...		37.25	57	51	53	47	61	S.	9	.38		Nimbus...	4.4	Hidden							Threatening.	

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,992.5 feet. Height of barometer at summit above ground, 3 feet. Observations taken at the summit station in ten feet and five feet below the highest point of the mountain.

Meteorological record for May 2, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.		THERM.		HYGROM.		WIND.			LOWER CLOUDS.		UPPER CLOUDS.		RAIN OR SNOW.		Maximum and minimum ther- mometer.	Remarks.
		Attached.	Exposed.	Dry bulb.	Wet bulb.	Relative humid- ity.	Direction.	Velocity per hour.	Pressure. R.	Daily ve- locity.	Kind.	Amount.	Kind.	Amount. (moving from)	Commen- d.	Ended.		
Summit	6.00 a. m.	32.810	68	40	40	100	S.W.	36	6.48	...	Nimbus...	4.4	Hidden	...	...	...	...	Heavy rain.
Base...	7.00 a. m.	37.15	55	45	47	83	N.E.	2	.02	...	Nimbus...	4.4	Hidden	...	...	...	...	Light rain.
Summit	7.00 a. m.	32.790	76	39	39	100	S.W.	54	14.58	...	Nimbus...	4.4	Hidden	...	...	...	...	Heavy rain.
Base...	7.57 a. m.	32.77	72	38	38	100	Calin.	...	...	...	Nimbus...	4.4	Hidden	...	...	...	...	Hail and rain.
Summit	7.57 a. m.	32.77	72	38	38	100	S.W.	36	6.48	...	Nimbus...	4.4	Hidden	...	...	...	...	Light rain.
Base...	9.00 a. m.	32.73	92	44	46	92	E.	2	.02	...	Nimbus...	4.4	Hidden	...	...	...	...	Heavy rain.
Summit	9.00 a. m.	32.730	70	37	37	100	S.W.	36	6.48	...	Nimbus...	4.4	Hidden	...	...	...	...	Heavy rain.
Base...	9.00 a. m.	32.73	92	44	46	92	S.E.	3	.04	...	Nimbus...	4.4	Hidden	...	...	...	...	Clearing; all clouds below summit.
Summit	10.00 a. m.	32.760	72	36	36	90	W.	66	21.78	...	Stratus...	2.4	Cumulus...	2.4	9.45 a. m.	...	...	Clearing up.
Base...	11.00 a. m.	32.711	53	46	47	83	S.W.	3	.04	...	Nimbus...	4.4	Hidden	...	...	...	...	Dense fog around summit.
Summit	11.00 a. m.	32.740	75	36	36	90	S.W.	66	21.78	...	Stratus...	4.4	Hidden	...	...	...	...	Clearing up.
Base...	12.00 m.	32.709	53	48	49	86	S.W.	2	.02	...	Stratus...	3.4	Hidden	...	...	...	...	Dense fog around summit.
Summit	12.00 m.	32.710	73	36	36	90	S.W.	57	16.34	...	Stratus...	4.4	Hidden	...	...	...	...	Fair.
Base...	1.00 p. m.	32.710	53	48	50	86	N.	2	.02	...	Cumulus...	1.4	Hidden	...	...	...	...	Dense fog around summit.
Summit	1.00 p. m.	32.739	74	38	38	90	S.W.	50	12.50	...	Stratus...	4.4	Hidden	...	...	...	...	Fair.
Base...	2.00 p. m.	32.710	56	51	52	90	N.W.	6	.18	...	Stratus...	4.4	Hidden	...	...	...	...	Fair.
Summit	2.00 p. m.	32.731	71	37	37	90	S.W.	36	6.48	...	Stratus...	4.4	Hidden	...	...	...	...	Fair.
Base...	3.00 p. m.	32.709	54	51	53	80	W.	6	.18	125	Clear	...	Cumulus...	3.4	S.W.	...	...	Cumulus clouds above and below summit.
Summit	3.00 p. m.	32.705	73	38	38	90	S.W.	54	14.38	...	Clear	...	Cumulus...	2.4	S.W.	...	...	Fair.
Base...	4.00 p. m.	32.706	55	56	57	69	N.	6	.18	...	Clear	...	Cumulus...	2.4	S.W.	...	...	Dense fog around summit.
Summit	4.00 p. m.	32.740	72	38	38	90	S.W.	36	6.48	...	Stratus...	4.4	Hidden	...	...	...	...	Threatening.
Base...	4.57 p. m.	32.707	55	53	54	74	S.W.	4	.08	...	Clear	...	Cumulus...	3.4	S.W.	...	...	Heavy rain.
Summit	4.57 p. m.	32.75	70	37	36	90	S.W.	34	5.78	...	Stratus...	4.4	Hidden	...	...	...	...	Hail, turned to rain.
Base...	6.00 p. m.	32.709	49	46	46	92	W.	2	.03	...	Nimbus...	4.4	Hidden	...	...	...	...	Heavy rain.
Summit	6.00 p. m.	32.730	68	34	34	100	W.	33	5.44	...	Nimbus...	4.4	Hidden	...	...	...	...	Heavy rain.
Base...	9.00 p. m.	32.711	55	55	55	92	Calin.	...	...	...	Nimbus...	4.4	Hidden	...	...	...	...	Light rain.
Summit	9.00 p. m.	32.729	73	32	32	91	W.	30	4.50	...	Nimbus...	4.4	Hidden	...	...	...	...	Snow and sleet.
Base...	11.57 p. m.	32.712	53	41	43	82	S.E.	4	.08	...	Stratus...	4.4	Hidden	...	...	...	...	Cloudy.
Summit	11.57 p. m.	32.76	61	39	39	92	S.E.	4	.02	...	Stratus...	4.4	Hidden	...	...	...	...
Base...		32.715	55			92	S.E.	2			Stratus...	4.4	Hidden	...	...	...	...

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,922.5 feet. Height of barometer at summit above ground, 3 feet. Elevation of base above sea-level, 2,615 feet. Height of barometer at base above ground, 24 feet.

Meteorological record for May 3, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM.		HYGROM.		WIND.			LOWER CLOUDS.		UPPER CLOUDS.		RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.
			Attached.	Exposed.	Dry bulb.	Wet bulb.	Relative humid- ity.	Direction.	Velocity per hour.	Pressure per sq. ft.	Daily va- locity.							
Summit	6.00 a. m.	27.70	68	30	30	30	100	S. W.	18	1.63		Kind	Amount	Kind	Amount			Light snow.
Base		27.11	50	36	30	37.5	95	Calm.				Hidden						Light rain.
Summit	7.00 a. m.	27.60	67	30	30	30	100	S. W.	12	.72		Hidden						Threatening.
Base		27.09	48	38	31	39	83	Calm.				Hidden						
Summit	7.57 a. m.	27.69	68	37	31	31	100	S. W.	12	.72		Hidden						
Base		27.08	46	37	30	38	91	Calm.				Hidden						
Summit	9.00 a. m.	27.66	70	31	31	30	89	S. ●	18	1.63		Hidden						Threatening.
Base		27.05	46	38	30	39	91	Calm.				Hidden						Dense fog around summit.
Summit	10.00 a. m.	27.67	68	30	30	30	89	S. W.	20	2.00		Hidden						Threatening.
Base		27.05	46	36	37	37	100	Calm.				Hidden						Spitting snow.
Summit	11.00 a. m.	27.63	72	30	30	30	89	S.	39	7.60		Hidden						Threatening.
Base		27.03	46	37	37	37	100	Calm.				Hidden						Dense fog around summit.
Summit	12.00 m.	27.61	74	30	30	30	89	S. W.	18	1.63		Hidden						Drizzling.
Base		27.04	46	35	37	36	91	Calm.				Hidden						Light snow and sleet.
Summit	1.00 p. m.	27.62	73	29	29	29	89	S. W.	25	3.12		Hidden						Sleet.
Base		27.02	46	36	37	36	91	Calm.				Hidden						Dense fog around summit.
Summit	2.00 p. m.	27.63	74	29	29	27	78	S. W.	30	4.50		Cirro-str.	2.4	S. W.				Light rain.
Base		27.02	45	35	36	36	100	N. W.	1	.01	76	Hidden						Clearing rapidly.
Summit	3.00 p. m.	27.61	71	28	28	28	96	S. W.	24	2.88		Cirrus	1.4	S. W.				Threatening.
Base		27.01	45	35	36	36	100	Calm.				Hidden						Dense fog on summit.
Summit	4.00 p. m.	27.61	71	28	28	28	96	S. W.	12	.72		Hidden						Clearing up.
Base		27.00	45	37	36	37	90	Calm.				Cumulus.	1.4	N. W.				Fair.
Summit	4.57 p. m.	27.61	70	28	28	27	88	W.	18	1.68		Cumulus.	2.4	N. W.	8.35 a. m.			Dense fog on summit.
Base		27.00	45	43	44	41	76	Calm.				Cumulus.	3.4	W.	10.30 a. m.			Fair.
Summit	6.00 p. m.	27.63	75	28	28	27	88	S. W.	15	1.12		Hidden						
Base		27.01	47	44	45	41	69	Calm.				Cumulus.	2.4	N. W.				
Summit	9.00 p. m.	27.65	77	24	24	23	87	S. W.	20	2.00		Cirrus	0	S. W.				
Base		27.04	45	32	33	33	100	Calm.				Clear	0	0				
Summit	11.57 p. m.	27.66	66	23	23	22	86	W.	23	2.42		Hidden						
Base		27.04	47	33	34	34	100	S. E.	4	.08		Hidden						

* Rain and sleet at intervals.

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,982.5 feet. Height of barometer at summit above ground, 3 feet. Elevation of base above sea-level, 2,615 feet. Height of barometer at base above ground, 34 feet.

Meteorological record for May 4, 1872..

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM.			HYGROM.		WIND.			LOWER CLOUDS.		UPPER CLOUDS.		RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.
			Attached.	Exposed.		Dry bulb.	Wet bulb.	Relative humid- ity.	Direction.	Velocity per hour.	Pressure per sq. ft.	Daily ve- locity.	Kind.	Amount.	Kind.	Amount. (moving from—)	Commented.	Ended.	
Summit	6.00 a. m.	27.810	51	94	94	94	94	87	N.E.	39	7.60		Stratus	4.4	Hidden				Threatening. Cloudy.
Base	7.00 a. m.	27.800	52	92	92	92	92	86	S.	33	5.44		Stratus	4.4	Hidden				Light snow.
Summit	7.00 a. m.	27.810	52	92	92	92	92	86	S.	33	5.44		Nimbus	4.4	Hidden				Light snow.
Base	7.57 a. m.	27.800	52	92	92	92	92	86	N.E.	30	4.50		Nimbus	4.4	Hidden				Heavy snow.
Summit	7.57 a. m.	27.820	52	92	92	92	92	86	N.W.	21	2.02		Nimbus	4.4	Hidden				Light snow.
Base	9.00 a. m.	27.805	53	93	93	93	93	86	N.W.	21	2.02		Nimbus	4.4	Hidden				Heavy snow.
Summit	9.00 a. m.	27.820	53	93	93	93	93	86	N.W.	21	2.02		Nimbus	4.4	Hidden				Light snow.
Base	10.00 a. m.	27.800	52	92	92	92	92	86	N.W.	24	2.88		Nimbus	4.4	Hidden				Heavy snow.
Summit	10.00 a. m.	27.800	53	93	93	93	93	86	N.W.	24	2.88		Nimbus	4.4	Hidden				Light snow.
Base	11.00 a. m.	27.800	53	93	93	93	93	86	N.W.	24	2.88		Nimbus	4.4	Hidden				Light snow.
Summit	11.00 a. m.	27.820	53	93	93	93	93	86	N.W.	24	2.88		Nimbus	4.4	Hidden				Light snow.
Base	12.00 m.	27.800	53	93	93	93	93	86	N.W.	36	6.48		Nimbus	4.4	Hidden				Heavy snow.
Summit	1.00 p. m.	27.800	53	93	93	93	93	86	N.W.	34	2.88		Nimbus	4.4	Hidden				Light snow.
Base	2.00 p. m.	27.831	54	94	94	94	94	86	Cal.	36	3.36	53	Nimbus	4.4	Hidden				Light snow.
Summit	2.00 p. m.	27.831	54	94	94	94	94	86	Cal.	36	3.36		Nimbus	4.4	Hidden				Heavy snow.
Base	3.00 p. m.	27.851	55	95	95	95	95	86	Cal.	36	3.36		Nimbus	4.4	Hidden				Light snow.
Summit	3.00 p. m.	27.851	55	95	95	95	95	86	Cal.	36	3.36		Nimbus	4.4	Hidden				Heavy snow.
Base	4.00 p. m.	27.841	55	95	95	95	95	86	Cal.	37	3.64		Nimbus	4.4	Hidden				Heavy snow.
Summit	4.00 p. m.	27.841	55	95	95	95	95	86	Cal.	37	3.64		Nimbus	4.4	Hidden				Heavy snow.
Base	4.57 p. m.	27.850	59	99	99	99	99	86	E.	18	1.62		Nimbus	4.4	Hidden				Heavy snow.
Summit	4.57 p. m.	27.850	59	99	99	99	99	86	E.	18	1.62		Nimbus	4.4	Hidden				Light snow.
Base	6.00 p. m.	27.859	60	99	99	99	99	86	N.W.	40	2.00		Nimbus	4.4	Hidden				Light snow.
Summit	6.00 p. m.	27.859	60	99	99	99	99	86	N.W.	40	2.00		Nimbus	4.4	Hidden				Light snow.
Base	9.00 p. m.	27.855	60	99	99	99	99	86	Cal.	96	46.08		Nimbus	4.4	Hidden				Heavy snow.
Summit	9.00 p. m.	27.855	60	99	99	99	99	86	Cal.	96	46.08		Nimbus	4.4	Hidden				Heavy snow.
Base	11.57 p. m.	27.870	65	99	99	99	99	86	Cal.	92	42.32		Nimbus	4.4	Hidden				Cloudy.
Summit	11.57 p. m.	27.870	65	99	99	99	99	86	Cal.	92	42.32		Nimbus	4.4	Hidden				Cloudy.
Base		27.816	46	31	33	33	33	90	W.	2	.02		Stratus	4.4	Hidden				Cloudy.

* Snow.

† Not enough to measure.

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,288.5 feet. Height of barometer at summit above ground, 3 feet. Elevation of base above sea-level, 2,615 feet. Height of barometer at base above ground, 94 feet.

Meteorological record for May 5, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM.			HYGROM. Relative humid- ity.	WIND.			LOWER CLOUDS.		UPPER CLOUDS.		RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.
			Atmosphere.	Exposed.	Dry bulb.	Wet bulb.	Direction.	Velocity per hour.	Pressure per sq. ft.	Daily ve- locity.	Kind.	Amount.	Kind.	Direction (moving from—)	Commenced.	Ended.		
Summit	6.00 a. m.	23.640	42	17	28	16	N.	36	6.48	...	Stratus	24	Cumulus	14	...	...	...	Fair.
Base	7.00 a. m.	23.620	45	17	15	15	N. E.	30	4.50	...	Stratus	34	Hidden	14	...	...	...	Fair.
Summit	7.00 a. m.	23.620	45	17	15	15	N. E.	30	4.50	...	Stratus	34	Hidden	14	...	...	...	Fair.
Base	7.57 a. m.	23.670	56	17	30	29	S.	40	8.00	...	Stratus	14	Cumulus	24	...	...	...	Fair.
Summit	7.57 a. m.	23.670	56	17	30	29	S.	40	8.00	...	Stratus	14	Cumulus	24	...	...	...	Fair.
Base	8.00 a. m.	23.670	58	17	33	30	N.	42	8.02	...	Stratus	14	Hidden	14	...	...	...	Fair.
Summit	9.00 a. m.	23.670	58	17	33	30	N.	42	8.02	...	Stratus	14	Hidden	14	...	...	...	Fair.
Base	9.00 a. m.	23.670	58	17	33	30	N.	42	8.02	...	Stratus	14	Hidden	14	...	...	...	Fair.
Summit	10.00 a. m.	23.685	64	18	34	32	N. W.	60	18.00	...	Stratus	44	Hidden	34	...	...	...	Fair.
Base	10.00 a. m.	23.685	64	18	34	32	N. W.	60	18.00	...	Stratus	44	Hidden	34	...	...	...	Fair.
Summit	11.00 a. m.	23.690	63	33	34	32	W.	30	4.50	...	Stratus	44	Hidden	34	...	...	...	Fair.
Base	11.00 a. m.	23.690	63	33	34	32	W.	30	4.50	...	Stratus	44	Hidden	34	...	...	...	Fair.
Summit	12.00 m.	23.690	66	36	35	35	N. W.	32	5.12	...	Stratus	44	Hidden	24	...	...	...	Fair.
Base	12.00 m.	23.690	66	36	35	35	N. W.	32	5.12	...	Stratus	44	Hidden	24	...	...	...	Fair.
Summit	1.00 p. m.	23.693	68	38	37	37	N. W.	24	2.88	...	Stratus	14	Cumulus	14	...	...	...	Fair.
Base	1.00 p. m.	23.693	68	38	37	37	N. W.	24	2.88	...	Stratus	14	Cumulus	14	...	...	...	Fair.
Summit	2.00 p. m.	23.691	62	43	39	40	N.	30	4.50	...	Stratus	24	Cumulus	34	...	...	...	Fair.
Base	2.00 p. m.	23.691	62	43	39	40	N.	30	4.50	...	Stratus	24	Cumulus	34	...	...	...	Fair.
Summit	3.00 p. m.	23.670	65	43	39	35	N.	29	4.20	61	Stratus	34	Cumulus	14	...	...	...	Fair.
Base	3.00 p. m.	23.670	65	43	39	35	N.	29	4.20	61	Stratus	34	Cumulus	14	...	...	...	Fair.
Summit	4.00 p. m.	23.640	62	43	39	35	N.	40	8.00	...	Stratus	34	Cumulus	14	...	...	...	Fair.
Base	4.00 p. m.	23.640	62	43	39	35	N.	40	8.00	...	Stratus	34	Cumulus	14	...	...	...	Fair.
Summit	4.57 p. m.	23.640	60	42	39	35	N. W.	45	10.12	...	Stratus	24	Cumulus	14	...	...	...	Fair.
Base	4.57 p. m.	23.640	60	42	39	35	N. W.	45	10.12	...	Stratus	24	Cumulus	14	...	...	...	Fair.
Summit	5.00 p. m.	23.600	63	43	41	37	N. W.	38	7.22	...	Stratus	24	Cumulus	24	...	...	...	Fair.
Base	5.00 p. m.	23.600	63	43	41	37	N. W.	38	7.22	...	Stratus	24	Cumulus	24	...	...	...	Fair.
Summit	6.00 p. m.	23.531	62	43	41	38	N. W.	60	18.00	...	Stratus	24	Clear	14	...	...	...	Fair.
Base	6.00 p. m.	23.531	62	43	41	38	N. W.	60	18.00	...	Stratus	24	Clear	14	...	...	...	Fair.
Summit	9.00 p. m.	23.480	52	16	35	31	N. W.	85	36.18	...	Stratus	44	Hidden	14	...	...	...	Fair.
Base	9.00 p. m.	23.480	52	16	35	31	N. W.	85	36.18	...	Stratus	44	Hidden	14	...	...	...	Fair.
Summit	11.57 p. m.	27.06	45	33	34	31	W.	6	...	...	Stratus	24	Clear	...	...	...	...	Fair.
Base	11.57 p. m.	27.06	45	33	34	31	W.	6	...	...	Stratus	24	Clear	...	...	...	...	Fair.

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,282.5 feet. Height of barometer at summit above ground, 3 feet. Elevation of base above sea-level, 2,615 feet. Height of barometer at base above ground, 24 feet.

Meteorological record for May 6, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM.			HYGROM.		Relative humid- ity.	WIND.			LOWER CLOUDS.		UPPER CLOUDS.		RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.
			Attached.	Exposed.		Dry bulb.	Wet bulb.		Direction.	Velocity per hour.	Pressure per sq. ft.	Daily ve- locity.	Kind.	Amount.	Kind.	Amount.	Direction (moving from—)	Comment.	Ended.	
Summit	6.00 a. m.	23.540	37	30	30	30	19	84	N.	24	2.88		Stratus	3-4	Hidden					Heavy Heavy snow.
Base	6.00 a. m.	23.540	47	30	30	30	19	85	N.W.	18	1.62		Nimbus	4-4	Hidden					Light snow.
Summit	7.00 a. m.	23.550	47	30	30	30	19	85	N.	9	2.02		Stratus	4-4	Hidden					Light snow.
Base	7.00 a. m.	23.550	47	30	30	30	19	85	S.	9	2.02		Nimbus	4-4	Hidden					Heavy snow.
Summit	7.57 a. m.	23.600	61	22	22	22	30	72	N.	24	2.88		Stratus	4-4	Hidden			Dur night 8.30 a. m.		Light snow.
Base	7.57 a. m.	23.600	61	22	22	22	30	72	Calm				Nimbus	4-4	Hidden					Light snow.
Summit	9.00 a. m.	23.620	63	23	23	23	22	86	N.	13	.64		Nimbus	4-4	Hidden					Heavy snow.
Base	9.00 a. m.	23.620	63	23	23	23	22	86	N.	13	.64		Nimbus	4-4	Hidden					Light snow.
Summit	10.00 a. m.	23.640	65	23	23	23	24	86	N.	8	.36		Nimbus	4-4	Hidden					Heavy snow.
Base	10.00 a. m.	23.640	65	23	23	23	24	86	N.	8	.36		Nimbus	4-4	Hidden					Light snow.
Summit	11.00 a. m.	23.655	67	24	24	24	23	86	N.	24	2.88		Nimbus	4-4	Hidden					Heavy snow.
Base	11.00 a. m.	23.655	67	24	24	24	23	86	N.	24	2.88		Nimbus	4-4	Hidden					Light snow.
Summit	12.00 m.	23.685	65	25	25	25	25	100	Calm	91	2.96		Nimbus	4-4	Hidden					Dense fog.
Base	12.00 m.	23.685	65	25	25	25	25	100	Calm	91	2.96		Nimbus	4-4	Hidden					Light snow.
Summit	1.00 p. m.	23.670	62	25	25	25	22	74	N.W.	94	2.88		Nimbus	4-4	Hidden					Dense fog.
Base	1.00 p. m.	23.670	62	25	25	25	22	74	N.W.	94	2.88		Nimbus	4-4	Hidden					Light snow.
Summit	2.00 p. m.	23.690	60	25	25	25	23	74	N.	25	3.12	110	Clear	1-4	Cumulus	9-4	N.E.			Dense fog.
Base	2.00 p. m.	23.690	60	25	25	25	23	74	N.	25	3.12	110	Clear	1-4	Cumulus	9-4	N.E.			Fair.
Summit	3.00 p. m.	23.690	61	26	26	26	24	76	N.	20	2.00		Clear	4-4	Hidden					Dense fog.
Base	3.00 p. m.	23.690	61	26	26	26	24	76	N.	20	2.00		Clear	4-4	Hidden					Fair.
Summit	4.00 p. m.	23.680	61	26	26	26	24	76	N.	22	2.40		Nimbus	4-4	Hidden					Dense fog.
Base	4.00 p. m.	23.680	61	26	26	26	24	76	N.W.	22	2.40		Clear	4-4	Hidden					Fair.
Summit	4.57 p. m.	23.660	60	26	26	26	25	88	N.	48	11.32		Nimbus	4-4	Hidden					Fair.
Base	4.57 p. m.	23.660	60	26	26	26	25	88	N.	48	11.32		Clear	4-4	Hidden					Fair.
Summit	6.00 p. m.	23.720	60	27	27	27	25	77	N.	40	8.00		Stratus	3-4	Cumulus	1-4	N.			Fair; hail from 1.20 to 1.30 p. m.
Base	6.00 p. m.	23.720	60	27	27	27	25	77	N.	40	8.00		Clear	3-4	Cumulus	1-4	N.			Heavy.
Summit	7.00 p. m.	23.740	58	25	25	25	23	88	N.	42	8.82		Nimbus	4-4	Hidden			8.00 p. m.		Fair.
Base	7.00 p. m.	23.740	58	25	25	25	23	88	N.	42	8.82		Clear	4-4	Hidden					Fair.
Summit	8.00 p. m.	23.716	45	32	32	32	28	88	N.	68	23.12		Nimbus	4-4	Hidden					Fair.
Base	8.00 p. m.	23.716	45	32	32	32	28	88	N.	68	23.12		Clear	4-4	Hidden					Fair.
Summit	11.57 p. m.	23.670	40	38	38	38	30	64	N.	2	.02		Clear	4-4	Cumulus	2-4	0	Dur night		Fair.
Base	11.57 p. m.	23.670	40	38	38	38	30	64	N.	2	.02		Clear	4-4	Cumulus	2-4	0			Fair.

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,282.5 feet. Height of barometer at summit above ground, 3 feet. Elevation of base above sea-level, 2,615 feet. Height of barometer at base above ground, 24 feet.

Meteorological record for May 7, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM.			HYGROM. Relative humid- ity.	WIND.			LOWER CLOUDS.		UPPER CLOUDS.		RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.
			Attached.	Exposed.	Dry bulb.	Wet bulb.	Direction.	Velocity per hour.	Pressure per sq. ft.	Daily ve- locity.	Kind.	Amount.	Kind.	Amount.	Direction, (moving from—)	Commen- d.	Ended.	
Summit	6.00 a. m.	23.750	56	32	31	89	N. W.	66	31.78	...	Nimbus	4.4	Hidden	...	...	...	...	Drizzling. Threatening.
Base	...	27.20	46	41	40	83	N. W.	66	31.78	...	Stratus	4.4	Hidden	...	...	...	...	Cloudy.
Summit	7.00 a. m.	23.740	62	33	41	79	N. E.	66	31.78	...	Stratus	4.4	Hidden	...	...	...	...	Threatening.
Base	...	27.20	46	41	40	83	N. E.	66	31.78	...	Stratus	4.4	Hidden	...	...	...	...	Dense fog.
Summit	7.57 a. m.	23.740	59	33	31	76	N. E.	72	32.92	...	Stratus	4.4	Hidden	...	...	...	...	Dense fog.
Base	...	27.21	46	34	34	76	N. E.	72	32.92	...	Stratus	4.4	Hidden	...	...	...	...	Fair.
Summit	9.00 a. m.	23.760	60	34	34	90	N. E.	68	32.12	...	Nimbus	4.4	Hidden	...	...	...	...	Dense fog.
Base	...	27.20	46	45	34	84	N. E.	68	32.12	...	Stratus	4.4	Hidden	...	...	...	...	Fair.
Summit	10.00 a. m.	23.770	59	35	34	90	N. W.	60	18.00	...	Nimbus	4.4	Hidden	...	...	...	...	Dense fog.
Base	...	27.21	46	48	34	78	N. W.	54	14.58	...	Stratus	4.4	Hidden	...	...	...	...	Fair.
Summit	11.00 a. m.	23.780	61	35	35	90	N. W.	54	14.58	...	Nimbus	4.4	Hidden	...	...	...	...	Dense fog.
Base	...	27.20	47	49	35	80	S. W.	54	14.58	...	Stratus	4.4	Hidden	...	...	...	...	Dense fog.
Summit	12.00 m.	23.800	61	36	35	90	N. W.	54	14.58	...	Nimbus	4.4	Hidden	...	...	...	...	Cloudy.
Base	...	27.21	49	51	35	80	N. W.	54	14.58	...	Stratus	4.4	Hidden	...	...	...	...	Cloudy.
Summit	1.00 p. m.	23.820	66	36	36	90	N. W.	50	12.50	...	Nimbus	4.4	Hidden	...	...	...	...	Cloudy.
Base	...	27.20	50	52	34	73	N. W.	48	11.52	...	Stratus	4.4	Hidden	...	...	...	...	Cloudy.
Summit	2.00 p. m.	23.850	64	37	36	90	N. W.	48	11.52	...	Stratus	4.4	Hidden	...	...	...	...	Cloudy.
Base	...	27.20	50	56	35	80	N. W.	48	11.52	...	Stratus	4.4	Hidden	...	...	...	...	Cloudy.
Summit	3.00 p. m.	23.880	68	37	37	86	N. W.	42	8.82	...	Stratus	4.4	Hidden	...	...	...	...	Clearing rapidly.
Base	...	27.19	54	57	35	53	N. W.	42	8.82	...	Stratus	4.4	Hidden	...	...	...	...	Fair.
Summit	4.00 p. m.	23.863	69	37	37	80	N. W.	40	8.18	...	Stratus	4.4	Hidden	...	...	...	...	Clearing rapidly.
Base	...	27.20	54	56	37	58	N. W.	40	8.18	...	Stratus	4.4	Hidden	...	...	...	...	Fair.
Summit	4.57 p. m.	23.880	72	38	38	90	N. W.	22	2.42	...	Stratus	4.4	Hidden	...	...	...	...	Fair.
Base	...	27.20	56	39	36	52	N. W.	22	2.42	...	Stratus	4.4	Hidden	...	...	...	...	Clearing rapidly.
Summit	6.00 p. m.	23.900	76	38	38	59	N. W.	20	2.00	...	Stratus	4.4	Hidden	...	...	...	...	Fair.
Base	...	27.22	58	39	38	52	N. W.	20	2.00	...	Stratus	4.4	Hidden	...	...	...	...	Clearing rapidly.
Summit	9.00 p. m.	23.896	65	37	37	84	N. W.	48	11.52	...	Stratus	4.4	Hidden	...	...	...	...	Fair.
Base	...	27.24	54	44	37	66	N. W.	48	11.52	...	Stratus	4.4	Hidden	...	...	...	...	Clear.
Summit	11.57 p. m.	23.900	68	37	37	80	N. W.	16	1.28	...	Stratus	4.4	Hidden	...	...	...	...	Clear.
Base	...	27.23	56	44	35	44	N. W.	6	1.18	...	Stratus	4.4	Hidden	...	...	...	...	Clear.

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,892.5 feet. Height of barometer at summit above ground, 3 feet. Elevation of base above sea-level, 2,915 feet. Height of barometer at base above ground, 24 feet.

Meteorological record for May 8, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM.		HYGROM.		WIND.				LOWER CLOUDS.		UPPER CLOUDS.			RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.
			Attached.	Exposed.	Dry bulb.	Wet bulb.	Relative humid- ity.	Direction.	Velocity per hour.	Pressure per sq. ft.	Daily ve- locity.	Kind.	Amount.	Kind.	Amount.	Direction (moving from—)	Commen- d.			
Summit	6.00 a. m.	23.880	57	38	38	80	N. W.	36	6.43	...	Hazy	...	Cumulus.	3.4	N. W.	...	...	...	Fair.
Base	...	27.25	51	43	36	84	E.	3	6.04	...	Clear	...	Cumulus.	4.4	0	...	...	...	Cloudy.
Summit	7.00 a. m.	23.880	58	38	38	80	N. W.	30	4.50	...	Hazy	...	Cumulus.	3.4	N. W.	...	...	...	Fair.
Base	...	27.28	50	42	43	92	E.	4	6.06	...	Stratus	1.4	Cumulus.	1.4	0	...	...	...	Fair.
Summit	7.57 a. m.	23.871	61	38	38	80	N. W.	28	3.92	...	Hazy	...	Cumulus.	2.4	N. W.	...	...	...	Fair.
Base	...	27.26	50	46	49	78	N. W.	2	5.44	...	Stratus	1.4	Clear	...	...	...	...	...	Fair.
Summit	9.00 a. m.	23.880	63	39	39	82	N. W.	33	...	...	Hazy	...	Cumulus.	1.4	N. W.	...	...	...	Fair.
Base	...	27.26	50	51	47	72	Calm	...	...	...	Clear	...	Cumulus.	1.4	0	...	...	...	Fair.
Summit	10.00 a. m.	23.890	61	37	37	80	N. W.	30	4.50	...	Hazy	...	Cumulus.	1.4	N. W.	...	...	...	Fair.
Base	...	27.30	52	51	52	67	Calm	...	...	...	Stratus	1.4	Cumulus.	2.4	N. W.	...	...	...	Fair.
Summit	11.00 a. m.	23.890	58	39	39	82	N. W.	35	6.13	...	Hazy	...	Cumulus.	1.4	N. W.	...	...	...	Fair.
Base	...	27.21	53	53	54	49	N. W.	4	6.08	...	Clear	...	Cumulus.	1.4	N.	...	...	...	Fair.
Summit	12.00 m.	23.890	57	40	40	88	N. W.	36	6.48	...	Hazy	...	Cumulus.	1.4	N. W.	...	...	...	Fair.
Base	...	27.23	54	55	56	49	N. W.	6	6.18	...	Clear	...	Clear	...	...	...	...	...	Fair.
Summit	1.00 p. m.	23.910	58	40	40	88	N. W.	30	4.50	...	Hazy	...	Cumulus.	1.4	N. W.	...	...	...	Clear.
Base	...	27.30	54	57	59	50	N. W.	6	6.18	...	Clear	...	Clear	...	...	...	...	...	Fair.
Summit	2.00 p. m.	23.915	55	59	60	73	N. W.	36	6.48	...	Hazy	...	Hazy	...	...	...	...	...	Clear.
Base	...	27.28	55	60	51	49	W.	4	6.08	111	Clear	...	Clear	...	...	...	...	...	Clear.
Summit	3.00 p. m.	23.935	59	59	60	53	N. W.	30	4.50	...	Hazy	...	Cir. & cu.	1.4	N. W.	...	...	...	Fair.
Base	...	27.30	59	60	53	55	S. W.	8	3.32	...	Hazy	...	Cirrus	1.4	N.	...	...	...	Fair.
Summit	4.00 p. m.	23.942	65	40	40	82	N. W.	27	3.64	...	Hazy	...	Cir. & cu.	1.4	N. W.	...	...	...	Fair.
Base	...	27.32	58	59	60	53	N. W.	6	6.18	...	Hazy	...	Cirrus	1.4	N.	...	...	...	Fair.
Summit	4.57 p. m.	23.960	67	40	40	82	N. W.	30	4.50	...	Clear	...	Cirrus	1.4	N. W.	...	...	...	Fair.
Base	...	27.32	59	59	59	53	N. W.	4	6.08	...	Clear	...	Cirrus	3.4	0	...	...	...	Cloudy.
Summit	6.00 p. m.	23.970	57	40	40	82	N. W.	30	4.50	...	Stratus	1.4	Cirrus	1.4	N. W.	...	...	...	Fair.
Base	...	27.33	59	55	56	51	W.	2	6.03	...	Stratus	2.4	Cirrus	1.4	N.	...	...	...	Fair.
Summit	9.00 p. m.	23.970	58	38	38	84	E.	3	3.12	...	Stratus	2.4	Cirrus	1.4	N. W.	...	...	...	Cloudy.
Base	...	27.34	58	43	43	84	E.	3	3.04	...	Stratus	3.4	Stratus	1.4	N. W.	...	...	...	Fair.
Summit	11.57 p. m.	23.950	62	36	36	77	E.	4	3.64	...	Stratus	4.4	Hidden	...	...	...	...	...	Cloudy.
Base	...	27.32	56	44	46	43	...	...	...	...	Stratus	3.4	Hidden	...	...	...	...	...	Cloudy.

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,292.5 feet. Height of barometer at summit above ground, 3 feet. Elevation of base above sea-level, 2,815 feet. Height of barometer at base above ground, 24 feet.

Meteorological record for May 9, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM.			HYGROM.		Relative humid- ity.	WIND.			LOWER CLOUDS.		UPPER CLOUDS.		RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.
			Attached.	Exposed.		Dry bulb.	Wet bulb.		Direction.	Velocity per hour.	Pressure per sq. ft.	Daily ve- locity.	Kind.	Amount.	Kind.	Amount.	Direction (moving from—)	Commen- d.	Ended.	
Summit	6.00 a. m.	23.900	56	39	39	38	91	W.	60	18.00			Nimbus	4.4	Hidden					Dense fog. Drizzling.
Base	7.00 a. m.	27.95	53	44	46	45	92	E.	2	0.03			Nimbus	3.4	Hidden					Threatening.
Summit	7.00 a. m.	23.870	56	39	38	91	W.	60	18.00				Nimbus	4.4	Hidden					
Base	7.57 a. m.	27.95	52	47	48	85	85	S. E.	4	0.08			Nimbus	4.4	Hidden					
Summit	7.57 a. m.	23.861	65	39	39	39	100	W.	58	16.82			Nimbus	4.4	Hidden					
Base	9.00 a. m.	27.96	51	46	47	85	85	E.	2	0.02			Nimbus	4.4	Hidden					
Summit	9.00 a. m.	23.851	68	41	41	40	90	N. W.	54	14.58			Nimbus	4.4	Hidden					
Base	10.00 a. m.	27.90	52	50	51	49	86	E.	4	0.08			Nimbus	4.4	Hidden					
Summit	10.00 a. m.	23.840	67	42	42	41	91	N. W.	45	10.12			Stratus	4.4	Hidden					
Base	11.00 a. m.	27.90	53	56	57	54	81	N. W.	6	1.18			Foggy		Cirrus	2.4	0			
Summit	11.00 a. m.	23.841	66	42	42	41	91	W.	36	6.48			Stratus	4.4	Hidden					
Base	12.00 m.	27.18	53	59	60	55	71	Calm					Hazy		Cumulus	3.4	W.			
Summit	12.00 m.	23.830	67	44	44	43	92	W.	37	6.84			Stratus	4.4	Hidden					
Base	1.00 p. m.	27.15	57	62	62	55	61	W.	2	0.02			Stratus	3.4	Hidden					
Summit	1.00 p. m.	23.831	70	45	45	43	85	W.	37	6.84			Stratus	2.4	Cirrus	1.4	W.			
Base	2.00 p. m.	27.13	59	63	63	56	62	S. W.	6	1.18			Stratus	3.4	Hidden					
Summit	2.00 p. m.	23.810	70	45	45	43	85	S. W.	45	10.12			Hazy		Cirrus	2.4	W.			
Base	3.00 p. m.	27.13	60	62	62	53	57	S. W.	6	1.18	102		Stratus	4.4	Hidden					
Summit	3.00 p. m.	23.797	71	46	46	43	76	S. W.	45	10.12			Hazy		Cirrus	2.4	W.			
Base	4.00 p. m.	27.11	60	62	62	53	56	S. W.	4	0.08			Stratus	4.4	Hidden					
Summit	4.00 p. m.	23.770	71	46	46	43	76	S. W.	42	8.82			Hazy		Cirrus	3.4	W.			
Base	4.57 p. m.	27.09	63	63	63	57	57	W.	8	3.22			Stratus	3.4	Hidden					
Summit	4.57 p. m.	23.760	73	47	47	44	74	W.	49	12.00			Hazy		Cirrus	2.4	W.			
Base	5.00 p. m.	27.08	63	65	66	58	59	W.	6	1.18			Stratus	3.4	Hidden					
Summit	5.00 p. m.	23.770	73	46	46	43	76	W.	40	8.00			Hazy		Cirrus	3.4	W.			
Base	6.00 p. m.	27.08	61	61	62	54	56	W.	4	0.08			Stratus	3.4	Cumulus	1.4	N. W.			
Summit	6.00 p. m.	23.708	61	61	62	54	56	W.	78	30.48			Stratus	1.4	Clear					
Base	7.00 p. m.	23.700	75	46	46	43	76	S. W.	78	30.48			Stratus	1.4	Clear					
Summit	7.00 p. m.	23.685	63	63	63	54	59	Calm					Stratus	3.4	Clear					
Base	11.57 p. m.	23.650	69	45	45	43	85	W.	84	35.98			Stratus	1.4	Clear					
Summit	11.57 p. m.	27.03	64	63	63	55	57	N. W.	13	6.84			Stratus	1.4	Clear					

* Not enough to measure.

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea level, 6,289.5 feet. Height of barometer at summit above ground, 3 feet. Elevation of base above sea level, 2,615 feet. Height of barometer at base above ground, 34 feet.

Meteorological record for May 10, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM.		HYGROM.	WIND.	LOWER CLOUDS.		UPPER CLOUDS.		RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.	
			Attached.	Exposed.			Dry bulb.	Wet bulb.	Relative humid- ity.	Direction.	Velocity per hour.	Pressure per sq. ft.				Daily va- riety.	Kind.	Amount.	Direction, (moving from—)	Commented.	Ended.
Summit	6.00 a. m.	32.600	57	37	37	36	90	W.	90	40.50	Nimbus	4.4	Hidden		Cloudy, (dense fog.)	
Base		27.12	62	49	50	46	86	N. W.	6	18	Stratus	2.4	Clear		Fair.	
Summit	7.00 a. m.	32.600	57	35	35	34	90	W.	90	40.50	Nimbus	4.4	Hidden		Cloudy.	
Base		27.15	59	48	46	35	85	N. W.	8	32	Clear		Cumulus.	3.4	N. W.	
Summit	7.57 a. m.	32.620	62	34	34	33	78	W.	88	38.72	Nimbus	4.4	Hidden	7.35 a. m.	Dur.night	
Base		27.17	59	48	46	45	78	N. W.	6	18	Clear		Cumulus.	9.4	N. W.	
Summit	9.00 a. m.	32.641	63	32	32	31	89	W.	84	35.28	Stratus	4.4	Hidden		Cloudy, (dense fog.)	
Base		27.18	58	47	47	44	77	N. W.	10	50	Clear		Cumulus.	9.4	N. W.	
Summit	10.00 a. m.	32.720	70	32	32	31	89	W.	72	25.92	Stratus	4.4	Hidden		Cloudy, (dense fog.)	
Base		27.30	57	48	44	44	70	N. W.	8	32	Clear		Cumulus.	3.4	N. W.	
Summit	11.00 a. m.	32.750	70	31	31	30	89	W.	66	21.78	Stratus	4.4	Hidden		Cloudy, (dense fog.)	
Base		27.31	59	50	50	46	72	N. W.	6	18	Clear		Cumulus.	2.4	N. W.	
Summit	12.00 m.	32.790	68	31	31	30	89	W.	60	12.00	Stratus	4.4	Hidden		Cloudy, (dense fog.)	
Base		27.28	58	48	48	44	70	N. W.	8	32	Stratus	4.4	Hidden		Cloudy, (dense fog.)	
Summit	1.00 p. m.	32.820	66	31	31	30	89	W.	60	12.00	Stratus	4.4	Hidden		Cloudy, (dense fog.)	
Base		27.31	57	46	45	43	84	W.	4	08	Stratus	4.4	Hidden		Cloudy, (dense fog.)	
Summit	2.00 p. m.	32.840	70	31	31	29	79	W.	54	14.58	Stratus	2.4	Hidden		Cloudy, (dense fog.)	
Base		27.33	56	47	47	43	70	W.	4	08	Stratus	4.4	Hidden		Cloudy, (dense fog.)	
Summit	3.00 p. m.	32.850	71	31	31	29	79	W.	50	12.60	Stratus	2.4	Hidden		Cloudy.	
Base		27.35	52	50	50	45	65	N. W.	4	08	Clear		Cumulus	1.4	N. W.	
Summit	4.00 p. m.	32.920	69	32	32	30	79	W.	30	4.50	Clear		Cumulus	1.4	N. W.	
Base		27.35	57	52	52	46	60	N. W.	4	08	Clear		Cumulus	1.4	N. W.	
Summit	4.57 p. m.	32.923	61	33	33	30	69	W.	24	2.88	Clear		Cumulus	2.4	N. W.	.01
Base		27.37	58	54	54	47	55	E.	3	04	Clear		Cumulus	2.4	N. W.	
Summit	6.00 p. m.	32.965	67	34	34	30	61	W.	28	3.92	Clear		Cumulus	2.4	N. W.	
Base		27.40	61	58	58	55	82	W.	2	02	Clear		Cumulus	1.4	N. W.	
Summit	9.00 p. m.	34.020	70	33	33	33	69	E.	36	6.48	Stratus	2.4	Clear		Fair.	
Base		27.43	56	39	40	39	91	E.	2	02	Stratus	1.4	Clear		Fair.	
Summit	11.57 p. m.	34.060	65	33	33	31	79	W.	32	5.12	Stratus	3.4	Hidden		Fair.	
Base		27.47	56	40	40	39	91	W.	4	08	Stratus	3.4	Hidden		Cloudy.	

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,292.5 feet. Height of barometer at summit above ground, 3 feet. Elevation of base above sea-level, 2,615 feet. Height of barometer at base above ground, 24 feet.

Meteorological record for May 11, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM.			HYGROM.	Relative humid- ity.	WIND.			LOWER CLOUDS.		UPPER CLOUDS.			RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.
			At shaded.	Exposed.	Dry bulb.	Wet bulb.		Direction.	Velocity per hour.	Pressure per sq. ft.	Daily ve- locity.	Kind.	Amount.	Kind.	Amount. (moving from—)	Commen- d.	Ended.			
Summit	6.00 a.m.	24.021	54	38	38	37	90	W.	36	6.48		Stratus	1-4	Cumulus.	3-4	W.				Fair.
Base	6.00 a.m.	27.45	50	40	40	40	82	Calm				Clear		Cumulus.	3-4	N.W.				Cloudy.
Summit	7.00 a.m.	24.051	57	41	40	39	91	W.	42	8.82		Hazy		Circo-strat	2-4	W.				Cloudy.
Base	7.00 a.m.	27.45	50	42	42	42	74	Calm				Stratus	4-4	Hidden						Cloudy.
Summit	7.37 a.m.	24.070	65	41	40	41	91	W.	42	8.82		Stratus	4-4	Hidden						Cloudy; dense fog.
Base	7.37 a.m.	27.44	50	44	44	41	76	Calm				Stratus	4-4	Hidden						Cloudy; dense fog.
Summit	9.00 a.m.	24.070	69	41	41	41	91	W.	42	8.82		Stratus	4-4	Hidden						Cloudy; dense fog.
Base	9.00 a.m.	27.43	51	47	47	44	77	Calm				Stratus	4-4	Hidden						Cloudy; dense fog.
Summit	10.00 a.m.	24.070	71	41	41	41	40	91	W.	40	8.00	Clear		Cumulus.	2-4	S.W.				Fair.
Base	10.00 a.m.	27.41	50	53	53	48	67	S.W.	6	18		Stratus	4-4	Hidden						Cloudy; dense fog.
Summit	11.00 a.m.	24.080	73	41	41	41	40	91	W.	46	10.58	Stratus	4-4	Hidden						Cloudy; dense fog.
Base	11.00 a.m.	27.43	51	54	54	49	67	W.	4	08		Stratus	4-4	Hidden						Cloudy; dense fog.
Summit	12.00 m.	24.062	72	50	50	49	91	W.	42	8.82		Clear		Cumulus.	3-4	S.W.				Cloudy; dense fog.
Base	12.00 m.	27.42	52	55	55	49	62	Calm				Stratus	4-4	Hidden						Cloudy; dense fog.
Summit	1.00 p.m.	24.050	73	41	41	41	40	91	W.	36	6.48	Clear		Cumulus.	3-4	S.W.				Cloudy.
Base	1.00 p.m.	27.40	52	55	55	50	68	W.	6	18		Stratus	4-4	Hidden						Clearing; clouds below summit.
Summit	2.00 p.m.	24.040	71	49	49	41	69	W.	40	8.00	76	Clear		Cumulus.	3-4	S.W.				Cloudy; clouds below summit.
Base	2.00 p.m.	27.39	54	56	56	51	69	W.	4	08		Hazy		Cumulus.	1-4	W.				Cloudy; clouds below summit.
Summit	3.00 p.m.	24.038	69	43	43	41	83	W.	48	11.52				Hidden						Cloudy; clouds below summit.
Base	3.00 p.m.	27.36	55	58	58	52	64	N.W.	4	08		Stratus	4-4	Hidden						Cloudy; clouds below summit.
Summit	4.00 p.m.	24.080	69	43	43	42	91	W.	50	12.50		Hazy		Cumulus.	3-4	W.				Fair; principally below summit.
Base	4.00 p.m.	27.38	50	59	59	52	59	N.W.	6	18		Clear		Cumulus.	1-4	W.				Fair.
Summit	4.57 p.m.	24.000	70	44	44	44	84	W.	32	5.12		Hazy		Cumulus.	3-4	W.				Fair.
Base	4.57 p.m.	27.55	53	56	56	51	69	Calm				Stratus	1-4	Clear						Fair.
Summit	6.00 p.m.	24.000	75	45	45	45	84	W.	54	14.58		Hazy		Cirrus	3-4	W.				Fair.
Base	6.00 p.m.	27.34	57	55	55	51	74	W.	2	08		Stratus	1-4	Clear						Fair.
Summit	9.00 p.m.	23.860	74	42	42	40	83	W.	60	21.78		Clear		Clear						Clear.
Base	9.00 p.m.	27.30	56	44	44	43	92	Calm				Clear		Clear						Clear.
Summit	11.57 p.m.	23.860	64	46	46	42	69	W.	72	25.92		Hazy		Clear					46-53	Clear.
Base	11.57 p.m.	27.37	57	49	49	46	78	W.	5	12		Hazy		Clear						Clear.

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,288.5 feet. Height of barometer at summit above ground, 3 feet. Elevation of base above sea-level, 2,615 feet. Height of barometer at base above ground, 34 feet.

Meteorological record for May 12, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM.		HYGROM.	WIND.	LOWER CLOUDS.		UPPER CLOUDS.		RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.	
			Attached.	Exposed.			Dry bulb.	Wet bulb.	Relative humid- ity.	Direction.	Velocity per hour.	Pressure per sq. ft.				Daily ve- locity.	Kind.	Amount.	Kind.	Amount. (from—)	Commen- d.	Ended.
Summit	6.00 a. m.	93.800	57	43	43	83	W.	32	5.12	Hazy	4-4	Hazy				Fair and hazy. Threatening.
Base...	7.15	97.15	54	50	48	86	E.	4	0.6	Stratus		Clear				Cloudy.
Summit	7.00 a. m.	93.790	60	43	43	83	W.	28	3.92	Stratus	4-4	Clear				Cloudy.
Base...	7.14	97.140	54	53	43	67	E.	3	0.5	Stratus		Clear				Cloudy.
Summit	7.57 a. m.	93.800	62	43	30	67	Calm	30	4.50	Stratus	4-4	Hidden				Threatening.
Base...	9.00 a. m.	93.790	67	43	30	69	W.	2	0.2	Stratus	4-4	Hidden				Threatening.
Summit	9.00 a. m.	93.790	69	43	36	68	W.	36	6.48	Stratus	4-4	Hidden				Threatening.
Base...	10.00 a. m.	97.14	54	58	30	70	W.	2	0.02	Stratus	4-4	Hidden				Cloudy; dense fog.
Summit	11.00 a. m.	93.760	68	41	8	83	W.	40	8.00	Stratus	4-4	Hidden				Cloudy; dense fog.
Base...	97.15	57	60	41	39	60	N.W.	8	6.12	Cumulus	3-4	W.				Fair.
Summit	12.00 m.	93.770	68	41	40	91	W.	35	6.32	Stratus	4-4	Hidden				Cloudy; clearing slightly.
Base...	97.14	57	60	43	60	60	W.	8	3.32	Cumulus	3-4	W.				Fair.
Summit	1.00 p. m.	93.785	68	43	43	83	W.	36	6.48	Stratus	3-4	Hidden				Cloudy; clearing slightly.
Base...	97.13	58	63	43	59	59	N.W.	10	5.00	Cumulus	3-4	W.				Fair.
Summit	2.00 p. m.	93.810	69	42	42	52	N.W.	30	4.50	Cumulus	3-4	N.W.				Cloudy.
Base...	97.13	59	64	44	44	52	W.	4	3.64	Cumulus	3-4	N.W.				Cloudy.
Summit	3.00 p. m.	93.810	69	44	34	54	W.	27	3.64	Cumulus	3-4	N.W.				Fair.
Base...	97.13	60	64	44	44	52	W.	6	1.8	Cumulus	3-4	Calm				Fair.
Summit	4.00 p. m.	93.795	69	45	24	76	W.	24	2.88	Cirro-cum.	3-4	W.				Fair.
Base...	97.13	62	66	46	6	64	W.	6	1.8	Cumulus	1-4	W.				Fair.
Summit	4.57 p. m.	93.800	67	45	56	60	N.W.	24	2.88	Stratus	3-4	N.W.				Fair.
Base...	97.11	62	68	48	40	60	W.	8	0.8	Cirrus	3-4	N.W.				Fair.
Summit	6.00 p. m.	93.800	71	64	67	67	N.W.	24	2.88	Cirrus	3-4	Calm				Fair.
Base...	97.12	63	63	44	57	73	W.	6	1.8	Cirro-cum.	3-4	N.W.				Fair.
Summit	9.00 p. m.	93.820	66	41	41	61	N.W.	7	0.25	Stratus	1-4	N.W.				Fair.
Base...	97.15	61	46	46	87	85	W.	4	0.6	Cirrus	2-4	N.W.				Fair.
Summit	11.57 p. m.	93.790	67	39	35	92	W.	13	0.8	Cirro-strat	0	0				Fair.
Base...	97.12	57	43	43	43	92	W.	4	0.6	Clear	1-4	Clear				Clear.

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,292.5 feet. Height of barometer at summit above ground, 3 feet. Elevation of base above sea-level, 2,615 feet. Height of barometer at base above ground, 24 feet.

Meteorological record for May 18, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.		THERM.		HYGROM.		WIND.		LOWER CLOUDS.		UPPER CLOUDS.		RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.
		Attached.	Exposed.	Dry bulb.	Wet bulb.	Relative humid- ity.	Direction.	Velocity per hour.	Pressure per sq. ft.	Daily ve- locity.	Kind.	Amount.	Kind.	Amount.	Direction (moving from—)	Commented.	Ended.	
Summit	6.00 a. m.	32.730	36	36	32	61	N. W.	7	.95		Clear		Cumulus	2-4	N. W.			Fair.
Base	6.00 a. m.	37.09	33	37	37	100	E.	5	.92		Clear		Cumulus	2-4	N. W.			Clear.
Summit	7.00 a. m.	32.740	36	37	33	70	N. W.	2	.93									Fair.
Base	7.00 a. m.	37.09	30	43	43	83	Calm	4	.98									Fair.
Summit	7.57 a. m.	32.760	37	37	33	62	N. W.	4										Fair.
Base	7.57 a. m.	37.10	31	48	44	70	Calm.											Fair.
Summit	9.00 a. m.	32.760	37	39	36	71	W.	2	.92		Hazy		Cirrus	1-4	W.			Fair.
Base	9.00 a. m.	37.10	31	51	46	65	W.	2	.92									Fair.
Summit	10.00 a. m.	32.760	38	38	35	71	W.	6	.91		Stratus	0	Cumulus	2-4	0			Cloudy—fog.
Base	10.00 a. m.	37.11	31	51	46	65	W.	4	.98		Stratus	0	Cumulus	3-4	0			Cloudy—fog.
Summit	11.00 a. m.	32.780	38	38	35	71	N. W.	4	.98		Stratus	0	Cumulus	3-4	0			Cloudy—fog.
Base	11.00 a. m.	37.12	31	50	46	72	W.	3	.95		Stratus	0	Cumulus	3-4	0			Cloudy—fog.
Summit	12.00 m.	32.800	37	37	33	80	W.	5	.92		Stratus	0	Cumulus	3-4	0			Cloudy—fog.
Base	12.00 m.	37.12	31	50	45	65	Calm.				Stratus	0	Cumulus	4-4	0			Threatening.
Summit	1.00 p. m.	32.780	37	35	33	80	W.	7	.95		Stratus	0	Cumulus	4-4	0			Threatening.
Base	1.00 p. m.	37.12	31	49	44	64	N. W.	2	.92		Stratus	0	Cumulus	4-4	0			Threatening.
Summit	2.00 p. m.	32.800	37	34	32	79	W.	7	.95		Stratus	0	Cumulus	4-4	0			Threatening.
Base	2.00 p. m.	37.12	31	48	45	78	Calm.				Stratus	0	Cumulus	4-4	0			Threatening.
Summit	3.00 p. m.	32.800	37	33	30	69	W.	8	.92		Stratus	0	Cumulus	4-4	0			Threatening.
Base	3.00 p. m.	37.12	31	48	44	64	W.	10	.90		Stratus	0	Cumulus	4-4	0			Threatening.
Summit	4.00 p. m.	32.780	37	32	30	79	W.	10	.90		Stratus	0	Cumulus	4-4	0			Threatening.
Base	4.00 p. m.	37.12	31	47	44	64	W.	10	.90		Stratus	0	Cumulus	4-4	0			Threatening.
Summit	4.57 p. m.	32.760	37	32	32	89	W.	18	1.02		Stratus	0	Cumulus	4-4	0			Threatening.
Base	4.57 p. m.	37.12	31	47	44	64	W.	10	.90		Stratus	0	Cumulus	4-4	0			Threatening.
Summit	6.00 p. m.	32.790	37	31	31	89	W.	18	1.02		Stratus	0	Cumulus	4-4	0			Threatening.
Base	6.00 p. m.	37.14	31	47	44	64	W.	10	.90		Stratus	0	Cumulus	4-4	0			Threatening.
Summit	9.00 p. m.	32.790	37	31	31	89	W.	18	1.02		Stratus	0	Cumulus	4-4	0			Threatening.
Base	9.00 p. m.	37.14	31	47	44	64	W.	10	.90		Stratus	0	Cumulus	4-4	0			Threatening.
Summit	11.57 p. m.	32.790	37	31	31	89	W.	18	1.02		Stratus	0	Cumulus	4-4	0			Threatening.
Base	11.57 p. m.	37.14	31	47	44	64	W.	10	.90		Stratus	0	Cumulus	4-4	0			Threatening.

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,288.5 feet. Height of barometer at summit above the ground, 3 feet. Elevation of base above sea-level, 2,615 feet. Height of barometer at base above the ground, 24 feet.

Meteorological record for May 14, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM.		HYGROM.		WIND.			LOWER CLOUDS.		UPPER CLOUDS.		RAIN OR SNOW.		Remarks.				
			Attached.	Exposed.	Dry bulb.	Wet bulb.	Relative humid- ity.	Direction.	Velocity per hour.	Pressure per sq. ft.	Daily ve- locity.	Kind.	Amount.	Kind.	Amount.		Direction. (moving from—)	Commenced.	Ended.	Amount of rain or melted snow.	Maximum and minimum ther- mometer.
Summit	6.00 a. m.	23.800.	43	25	25	21	78	N.	36	6.48		0	0	0	0	Cirro-strat.	24	N.		Fair.
Base	27.29	27.29	46	36	36	33	70	Cal.				0	0	0	0	Cumulus	14	0		Fair.
Summit	7.00 a. m.	23.820	45	25	25	21	48	N.	36	6.48		0	0	0	0	Cirro-strat.	14	0		Fair.
Base	27.31	27.31	42	39	39	34	55	Cal.				0	0	0	0	Cumulus	24	0		Fair.
Summit	7.57 a. m.	23.850.	47	26	26	22	49	N.	30	4.30		0	0	0	0	Cirro-strat.	14	N.		Clear.
Base	27.32	27.32	43	44	44	37	45	N.W.				0	0	0	0	0	0			Clear.
Summit	9.00 a. m.	23.880.	58	27	27	24	66	N.	12	7.2		0	0	0	0	Cirro-strat.	14	N.		C. clear.
Base	27.32	27.32	44	45	45	38	46	N.W.				0	0	0	0	0	0			C. clear.
Summit	10.00 a. m.	23.900	60	28	28	25	59	N.	13	5.12		0	0	0	0	Cirro cum.	14	N.		Clear.
Base	27.32	27.32	45	48	48	40	43	N.W.				0	0	0	0	0	0			Fair.
Summit	11.00 a. m.	23.930	67	30	30	26	39	N.W.	6	12		0	0	0	0	Cumulus	14	N.W.		Fair.
Base	27.32	27.32	46	49	49	41	44	N.W.	7	25		0	0	0	0	Cumulus	24	N.		Fair.
Summit	12.00 m.	23.933	66	31	31	27	60	N.W.	7	15		0	0	0	0	Cumulus	24	N.W.		Fair.
Base	27.32	27.32	47	50	50	41	39	N.W.	15	1.12		0	0	0	0	Cumulus	34	0		Fair.
Summit	1.00 p. m.	23.940	64	32	32	28	60	N.W.	6	18		0	0	0	0	Cumulus	24	N.W.		Fair.
Base	27.32	27.32	48	52	52	42	35	E.	20	2.00		0	0	0	0	Cumulus	24	N.W.		Fair.
Summit	2.00 p. m.	23.950	63	33	33	28	50	N.W.	67			0	0	0	0	Cumulus	24	N.W.		Fair.
Base	27.33	27.33	49	51	51	42	40	N.W.	4	05		0	0	0	0	Cumulus	24	N.W.		Fair.
Summit	3.00 p. m.	23.950	65	34	34	29	51	N.W.	10	59		0	0	0	0	Cumulus	24	N.W.		Fair.
Base	27.33	27.33	49	53	53	43	36	N.W.	4	04		0	0	0	0	Cumulus	24	N.W.		Fair.
Summit	4.00 p. m.	23.960	66	34	34	31	29	N.W.	3	4.70		0	0	0	0	Cirro cum.	24	N.W.		Fair.
Base	27.34	27.34	50	53	53	43	36	N.W.	6	18		0	0	0	0	Cumulus	34	0		Fair.
Summit	4.57 p. m.	23.965	67	34	34	29	51	N.W.	26	3.32		0	0	0	0	Cirro cum.	34	N.W.		Fair.
Base	27.36	27.36	51	54	54	44	38	N.W.	32		Hazy	0	0	0	0	Cumulus	34	N.W.		Fair.
Summit	6.00 p. m.	23.970	68	34	34	30	51	N.W.	24	3.92		0	0	0	0	Cirro cum.	24	N.W.		Fair.
Base	27.37	27.37	52	54	54	48	61	N.W.	18	1.62		0	0	0	0	Cumulus	24	0		Fair.
Summit	9.00 p. m.	23.970	68	29	29	26	67	N.W.	18	1.62		0	0	0	0	Cumulus	14	W.		Fair.
Base	27.40	27.40	52	39	39	30	73	N.W.	9	40		0	0	0	0	0	0			Clear.
Summit	11.57 p. m.	23.970	63	28	28	24	77	N.W.	9	40		14	0	0	0	Cirrus	0	14	N.W.	34-50
Base	27.40	27.40	52	39	39	36	73	Cal.				0	0	0	0	0	0			Clear.

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,282.5 feet. Height of barometer at summit above the ground, 3 feet. Elevation of base above sea-level, 2,615 feet. Height of barometer at base above the ground, 24 feet.

Meteorological record for May 15, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM.			HYGROM.		WIND.				LOWER CLOUDS.		UPPER CLOUDS.			RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.
			Attached.	Exposed.	Dry bulb.	Wet bulb.	Relative humid- ity.	Direction.	Velocity per hour.	Pressure per sq. ft.	Daily ve- locity.	Kind.	Amount.	Kind.	Amount.	Kind.	Amount. (moving from—)	Commenced.				Ended.
Summit	6.00 a.m.	23.940	51	27	27	25	77	W.	3	.05	0	0	Hazy	0	Hazy					Hazy.	
Base...	6.30 a.m.	27.40	46	38	39	36	73	E.	3	.05	Hazy	Hazy			Hazy					Hazy.	
Summit	7.00 a.m.	23.961	57	27	27	27	77	W.	3	.05	0	0	Hazy	0	Hazy					Hazy.	
Base...	7.30 a.m.	27.39	45	42	42	37	58	Calm			0	0	Hazy	0	Hazy					Hazy.	
Summit	7.57 a.m.	23.980	64	27	27	27	75	W.	3	.05	0	0	Cir-strat.	1.4	W.					Fair.	
Base...	8.00 a.m.	27.40	45	45	45	39	46	S.E.	1	.01	0	0	Hazy	0	Hazy					Light snow.	
Summit	8.30 a.m.	23.972	66	28	28	27	88	N.W.	10	.50	Nimbus	4.4	Hidden	4.4	Hidden					Cloudy.	
Base...	9.00 a.m.	27.40	45	43	43	37	51	N.W.	4	.08	Stratus	4.4	Hidden	4.4	Hidden					Cloudy.	
Summit	9.30 a.m.	23.972	66	28	28	27	88	W.	7	.25	Nimbus	2.4	Cirro-strat.	1.4	W.					Clearing.	
Base...	10.00 a.m.	27.39	45	44	44	38	52	N.W.	7	.02	0	0	Cumulus	3.4	W.					Cloudy.	
Summit	10.30 a.m.	23.960	65	29	29	28	89	W.	7	.25	Hazy	0	0	Cumulus	3.4	W.				Fair.	
Base...	11.00 a.m.	27.38	47	47	47	40	48	W.	2	.02	0	0	Cumulus	3.4	W.					Cloudy.	
Summit	11.30 a.m.	23.952	64	30	30	29	89	W.	12	.72	Stratus	3.4	Cirro-strat	1.4	W.					Fair.	
Base...	12.00 m.	27.38	46	47	47	40	48	W.	2	.02	0	0	Cumulus	3.4	0					Cloudy.	
Summit	1.00 p.m.	23.962	67	30	30	29	89	W.	10	.50	Hazy	0	0	Cumulus	3.4	N.W.				Cloudy.	
Base...	1.30 p.m.	27.36	46	48	48	41	49	N.W.	4	.08	0	0	Cumulus	3.4	N.W.					Fair.	
Summit	2.00 p.m.	23.950	68	31	31	30	89	N.W.	12	.72	0	0	Cumulus	3.4	N.W.					Fair.	
Base...	2.30 p.m.	27.34	46	47	47	40	48	W.	4	.08	0	0	Cumulus	3.4	N.W.					Light snow.	
Summit	3.00 p.m.	23.959	69	31	31	30	89	W.	24	2.88	Nimbus	4.4	Hidden	4.4	Hidden					Threatening.	
Base...	3.30 p.m.	27.33	46	45	45	40	61	N.W.	6	.18	Nimbus	3.4	Hidden	4.4	Hidden					Light snow.	
Summit	3.57 p.m.	23.950	72	29	29	28	88	W.	30	4.50	Nimbus	4.4	Hidden	4.4	Hidden					Light rain.	
Base...	4.00 p.m.	27.35	47	43	43	40	75	Calm			0	0	Hidden								
Summit	4.37 p.m.	23.900	69	28	28	27	88	N.	36	6.48	Stratus	2.4	Cumulus	2.4	Cumulus	2.4	N.	8.50 a.m. 2.30 p.m.	10 10 a.m. 4 40 p.m.	.02	Snow.
Base...	5.00 p.m.	27.35	48	48	48	44	70	N.W.	2	.02	0	0	Cumulus	1.4	N.W.					Clearing.	
Summit	5.30 p.m.	23.900	64	28	28	27	88	N.	36	6.48	Stratus	3.4	Cumulus	1.4	N.W.					Cloudy.	
Base...	6.00 p.m.	27.34	48	45	45	40	61	N.W.	4	.08	0	0	Cumulus	4.4	N.W.					Threatening.	
Summit	6.30 p.m.	23.870	65	28	28	25	86	N.	62	19.22	0	0	Cumulus	3.4	N.					Clear.	
Base...	7.00 p.m.	27.35	49	37	37	36	90	S.E.	4	.08	0	0	0	0	0						
Summit	7.35 p.m.	23.800	66	34	34	33	87	N.	55	15.12	0	0	0	0	0					31-34	
Base...	11.57 p.m.	27.33	50	34	34	35	90	E.	4	.08	0	0	0	0	0					Clear.	

* Not enough to measure.

Station, summit and base of Mount Washington, New Hampshire. Elevation of the summit above sea-level, 6,293.5 feet, Height of barometer at summit above ground, 3 feet. Elevation of the base above sea-level, 9,615 feet. Height of barometer at base above ground, 34 feet.

Meteorological record for May 16, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM. IN GRAD.			WIND.			LOWER CLOUDS.		UPPER CLOUDS.		RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.
			Attached.	Exposed.	Wet bulb.	Relative humid- ity.	Direction.	Velocity per hour.	Pressure per sq. ft.	Daily ve- locity.	Kind.	Amount.	Kind.	Amount.			
Summit	6.00 a.m.	32.640	35	16	16	83	N	66	21.78	...	Stratus...	3.4	Cumulus...	1.4	N	...	Fair.
Base...		37.97	13	30	30	78	N	9	62	...	0	0	0	0	N	...	Clear.
Summit	7.00 a.m.	32.651	13	15	15	78	N	62	19.92	...	Stratus...	3.4	Cumulus...	1.4	N	...	Fair.
Base...		37.95	14	30	30	67	N.E.	4	64	...	0	0	0	0	N	...	Fair.
Summit	7.57 a.m.	32.630	30	15	15	68	S.E.	66	21.72	...	Stratus...	2.4	Cumulus...	1.4	N	...	Fair.
Base...		37.21	41	32	32	68	S.E.	4	64	...	0	0	0	0	N	...	Fair.
Summit	9.00 a.m.	32.610	31	17	17	63	N.W.	60	18.90	...	0	0	0	0	N.W.	...	Clear.
Base...		37.21	41	36	36	55	W.	9	62	...	0	0	0	0	W.	...	Fair.
Summit	10.00 a.m.	32.618	31	18	18	54	W.	73	25.72	...	0	0	0	0	W.	...	Clear.
Base...		37.17	41	39	39	54	N.W.	13	72	...	0	0	0	0	W.	...	Fair.
Summit	11.00 a.m.	32.660	33	20	20	52	N.W.	56	16.50	...	Hazy	0	Cirrus...	1.4	N.W.	...	Fair.
Base...		37.15	42	41	41	52	N	16	50	...	0	0	0	0	W.	...	Fair.
Summit	12.00 m.	32.660	31	21	21	52	N	66	21.72	...	Hazy	0	Cirrus...	1.4	W.	...	Fair.
Base...		37.16	43	43	43	50	W.	10	50	...	0	0	0	0	W.	...	Fair.
Summit	1.00 p.m.	32.632	33	23	23	49	N	70	24.50	...	Hazy	0	Cirrus...	1.4	W.	...	Fair.
Base...		37.15	43	42	42	42	N	10	50	...	0	0	0	0	N	...	Fair.
Summit	2.00 p.m.	32.670	36	24	24	42	N	54	14.50	...	Hazy	0	Cumulus...	3.4	N	...	Fair.
Base...		37.14	42	42	42	42	N	54	14.50	108	0	0	Cumulus...	3.4	N	...	Fair.
Summit	3.00 p.m.	32.640	36	24	24	41	N	54	14.50	...	Hazy	0	Cumulus...	3.4	N	...	Cloudy.
Base...		37.14	42	42	42	41	N	9	40	...	0	0	Cumulus...	3.4	N	...	Cloudy.
Summit	4.00 p.m.	32.610	32	22	22	39	N	66	21.72	...	Hazy	0	Cirrus...	3.4	N	...	Cloudy.
Base...		37.16	42	42	42	39	N	8	32	...	0	0	Cirrus...	3.4	N	...	Threatening.
Summit	4.57 p.m.	32.610	34	23	23	37	N	68	23.12	...	Stratus...	1.4	Cirrus...	3.4	N	...	Threatening.
Base...		37.16	42	41	41	34	N.W.	4	09	...	0	0	Cirrus...	3.4	N	...	Threatening.
Summit	6.00 p.m.	32.691	34	23	23	36	N	58	16.32	...	Hazy	0	Cumulus...	3.4	N	...	Threatening.
Base...		37.16	43	41	41	36	N.W.	8	32	...	0	0	Cumulus...	3.4	N	...	Threatening.
Summit	8.00 p.m.	32.680	33	22	22	35	N.W.	72	23.52	...	Stratus...	1.4	Cumulus...	1.4	N	...	Fair.
Base...		37.18	44	38	38	33	W.	4	08	...	0	0	Cumulus...	1.4	N	...	Fair.
Summit	11.57 p.m.	32.700	30	22	22	31	E.	64	21.45	...	Stratus...	4.4	Hidden...	1.4	0	...	Fair.
Base...		37.18	43	35	35	32	E.	1	01	...	0	0	0	0	0	...	Fair.

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,982.5 feet. Height of barometer at summit above ground, 3 feet. Elevation of base above sea-level, 2,615 feet. Height of barometer at base above ground, 34 feet.

Meteorological record for May 17, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM.		HYGROM.		WIND.		LOWER CLOUDS.		UPPER CLOUDS.		RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.
			Attached.	Exposed.	Dry bulb.	Wet bulb.	Relative humid- ity.	Direction.	Velocity per hour.	Pressure per sq. ft. Daily ve- locity.	Kind.	Amount.	Kind.	Amount.			
Summit	6.00 a.m.	23.731	60	22	22	22	100	N.	24	2.88	Nimbus	4.4	Hidden				Light snow.
Base	27.18	23.730	43	35	35	33	80	W.	2	.02	Stratus	4.4	Hidden				Threatening.
Summit	7.00 a.m.	23.730	60	23	23	22	86	W.	36	6.48	Stratus	4.4	Hidden				Cloudy.
Base	27.18	23.730	42	36	36	34	80	Calm			Stratus	1.4	Cumulus		.05		Snow.
Summit	7.57 a.m.	23.741	58	24	24	23	87	N.	30	4.50	Stratus	4.4	Hidden				Cloudy—fog.
Base	27.19	23.741	42	39	39	36	73	W.	4	.08	Stratus	1.4	Cumulus				Cloudy—fog.
Summit	9.00 a.m.	23.756	62	25	25	24	87	W.	2	.02	Stratus	4.4	Hidden				Cloudy.
Base	27.18	23.756	42	40	40	37	73	W.	2	.02	Stratus	1.4	Cumulus				Cloudy—fog.
Summit	10.00 a.m.	23.760	61	25	25	24	87	W.	2	.02	Stratus	4.4	Hidden				Cloudy.
Base	27.18	23.760	43	41	41	38	74	W.	2	.03	Stratus	1.4	Cumulus				Cloudy.
Summit	11.00 a.m.	23.762	64	27	27	25	77	N.E.	5	3.12	Hazy	0	Cumulus				Fair.
Base	27.17	23.762	47	47	47	41	55	S.	4	.08	Cumulus	0	Cumulus				Fair.
Summit	12.00 m.	23.800	71	29	29	27	78	N.E.	22	2.42	Hazy	0	Cumulus				Fair.
Base	27.16	23.800	45	50	49	43	57	S.	5	.13	Cumulus	0	Cumulus				Fair.
Summit	1.00 p.m.	23.800	69	30	30	28	78	N.E.	1	.01	Hazy	0	Cumulus				Fair.
Base	27.16	23.800	45	51	51	44	52	W.	5	.12	Cumulus	0	Cumulus				Fair.
Summit	2.00 p.m.	23.800	69	31	31	29	89	N.E.	7	.25	Cumulus	0	Cumulus				Fair.
Base	27.16	23.810	42	51	51	44	52	W.	5	1.2	Cumulus	0	Cumulus				Fair.
Summit	3.00 p.m.	23.810	64	32	32	31	89	N.	7	.25	Cumulus	0	Cumulus				Fair.
Base	27.16	23.820	42	50	50	43	51	W.	2	.02	Cumulus	0	Cumulus				Fair.
Summit	4.00 p.m.	23.820	65	32	32	31	89	N.E.	8	.32	Cumulus	0	Cumulus				Cloudy.
Base	27.16	23.830	48	50	50	43	51	W.	2	.02	Cumulus	0	Cumulus				Cloudy.
Summit	4.57 p.m.	23.800	67	32	32	30	79	N.E.	9	.40	Cumulus	0	Cumulus				Cloudy.
Base	27.17	23.810	48	51	51	44	52	W.	3	.05	Cumulus	0	Cumulus				Cloudy.
Summit	6.00 p.m.	23.810	67	32	32	31	89	N.E.	5	.13	Cumulus	0	Cumulus				Cloudy.
Base	27.17	23.820	49	50	50	43	51	Calm			Cumulus	0	Cumulus				Clear.
Summit	9.00 p.m.	23.830	69	29	29	27	73	Calm			Cumulus	0	Cumulus				Clear.
Base	27.20	23.840	52	40	40	37	77	N.E.	5	.12	Cumulus	0	Cumulus				Clear.
Summit	11.57 p.m.	23.800	64	28	28	26	77	E.	4	.08	Cumulus	0	Cumulus				Clear.
Base	27.20	23.800	53	38	38	37	90				Cumulus	0	Cumulus				Clear.

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,288.5 feet. Height of barometer at summit above ground, 3 feet. Elevation of base above sea-level, 2,615 feet. Height of barometer at base above ground, 24 feet.

Meteorological record for May 18, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM.		HYGROM.		WIND.		LOWER CLOUDS.		UPPER CLOUDS.		RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.
			Attached.	Exposed.	Dry bulb.	Wet bulb.	Relative humid- ity.	Direction.	Velocity per hour.	Pressure per sq. ft. Daily ve- locity.	Kind.	Amount.	Kind.	Amount. (moving from—)				Compend. ended.
Summit	6.00 a.m.	33.780	55	36	77	N.W.	12	.72		Hazy	0	Cirro-strat	14	N.W.		Fair.	
Base	6.00 a.m.	27.18	46	35	90	E.	4	.04		0	0	0	0			Clear.	
Summit	7.00 a.m.	33.771	53	39	78	N.W.	12	.72		Hazy	0	Cirro-strat	14	N.W.		Clear.	
Base	7.00 a.m.	27.17	45	41	74	E.	4	.04		0	0	0	0				
Summit	7.57 a.m.	33.771	53	30	68	N.	10	.50		Hazy	0	Cirro-cum.	14	N.			
Base	7.57 a.m.	27.18	46	47	55	N.E.	4	.04		0	0	Cirrus	18	N.W.		Clear.	
Summit	9.00 a.m.	33.800	60	32	69	N.W.	6	.12		0	0	Cumulus	14	N.W.		Fair.	
Base	9.00 a.m.	27.17	46	47	62	N.W.	4	.04		0	0	Cirrus	14	N.W.		Fair.	
Summit	10.00 a.m.	33.810	63	33	69	N.W.	4	.04		0	0	Cumulus	14	N.W.		Fair.	
Base	10.00 a.m.	27.17	48	50	54	N.W.	4	.04		0	0	Cirrus	14	N.E.		Fair.	
Summit	11.00 a.m.	33.810	62	36	53	N.E.	4	.04		0	0	Cumulus	14	N.		Fair.	
Base	11.00 a.m.	27.17	49	51	53	W.	4	.04		0	0	Cumulus	14	N.		Fair.	
Summit	12.00 m.	33.800	62	36	53	N.W.	3	.05		0	0	Cumulus	24	N.W.		Fair.	
Base	12.00 m.	27.15	51	55	45	S.W.	4	.04		0	0	Cumulus	18	0		Clear.	
Summit	1.00 p.m.	33.830	61	39	34	N.W.	1	.01		0	0	Cumulus	24	N.W.		Fair.	
Base	1.00 p.m.	27.14	54	58	48	W.	4	.04		0	0	Cumulus	14	N.W.		Fair.	
Summit	2.00 p.m.	33.800	67	38	33	N.W.	10	.50		Hazy	0	Cumulus	24	N.W.		Fair.	
Base	2.00 p.m.	27.13	54	58	47	W.	4	.08	87	0	0	Cumulus	14	0		Fair.	
Summit	3.00 p.m.	33.810	65	40	35	N.W.	5	.12		0	0	Cumulus	24	N.W.		Fair.	
Base	3.00 p.m.	27.11	56	60	49	W.	5	.12		0	0	Cumulus	18	0		Fair.	
Summit	4.00 p.m.	33.780	64	41	41	N.W.	15	1.12		0	0	Cumulus	24	N.W.		Fair.	
Base	4.00 p.m.	27.11	58	61	49	S.W.	8	.32		0	0	0	0			Clear.	
Summit	4.57 p.m.	33.780	67	41	41	N.E.	13	.84		0	0	Cumulus	14	N.E.		Clear.	
Base	4.57 p.m.	27.10	59	61	49	W.	6	.18		0	0	0	0			Clear.	
Summit	6.00 p.m.	33.756	70	41	41	N.E.	24	2.88		0	0	Cumulus	14	N.E.		Clear.	
Base	6.00 p.m.	27.10	61	61	49	W.	7	.35		0	0	0	0			Clear.	
Summit	9.00 p.m.	33.770	71	40	35	N.W.	24	2.58		Hazy	0	Cirro-strat	14	N.W.		Clear.	
Base	9.00 p.m.	27.09	59	46	47	W.	4	.06		0	0	0	0			Clear.	
Summit	11.57 p.m.	33.750	69	37	34	N.W.	22	2.42		Hazy	0	Cirrus	14	N.W.		Clear.	
Base	11.57 p.m.	27.08	54	42	84	S.E.	4	.08		0	0	0	0			Clear.	

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,282.5 feet. Height of barometer at summit above ground, 3 feet. Elevation of base above sea-level, 2,615 feet. Height of barometer at base above ground, 24 feet.

Meteorological record for May 19, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.		THERM.		HYGROM.		WIND.			LOWER CLOUDS.		UPPER CLOUDS.			RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.
		Attached.	Exposed.	Dry bulb.	Wet bulb.	Relative humi- dity.	Direction.	Velocity per hour.	Pressure per sq. ft.	Daily ve- locity.	Kind.	Amount.	Direction (moving from—)	Commenced.	Ended.					
Summit	6.00 a. m.	23.709	62	35	31	61	E.	6	.18	...	0	0	Cirrus	2-4	E.	...	...	Fair.	
Base...	...	27.02	65	44	44	68	E.	4	.08	...	Hazy	...	...	...	...	...	...	Hazy.	
Summit	7.00 a. m.	23.700	51	37	30	37	S.W.	18	1.62	...	Stratus	1-4	S.W.	1-4	S.W.	...	...	Hazy	
Base...	...	27.01	51	30	30	51	E.	4	.08	...	Hazy	...	...	...	...	...	...	Hazy	
Summit	7.57 a. m.	23.710	71	38	38	30	E.	19	1.80	...	Stratus	1-4	E.	2-4	E.	...	...	Hazy	
Base...	...	26.99	52	34	34	45	Calm.	...	...	...	Dense haze	...	...	...	...	...	...	Hazy.	
Summit	9.00 a. m.	23.718	76	39	39	31	S.W.	15	1.12	...	Stratus	1-4	S.W.	2-4	S.W.	...	...	Hazy.	
Base...	...	26.99	52	36	36	45	S.	4	.08	...	Dense haze	...	...	...	...	...	...	Hazy.	
Summit	10.00 a. m.	23.680	69	42	42	37	S.E.	20	2.00	...	Stratus	1-4	S.E.	2-4	S.E.	...	...	Hazy.	
Base...	...	26.96	53	38	38	50	S.	6	.18	...	Dense haze	...	...	...	...	...	...	Hazy.	
Summit	11.00 a. m.	23.680	74	44	44	41	S.W.	30	4.50	...	Stratus	3-4	0	0	0	...	...	Cloudy.	
Base...	...	26.96	56	39	39	53	S.E.	6	.18	...	Hazy	...	...	...	...	...	...	Fair.	
Summit	12.00 m.	23.670	75	43	43	41	S.W.	28	3.92	...	Stratus	4-4	...	...	...	...	...	Cloudy—fog.	
Base...	...	26.96	58	38	38	53	S.E.	8	.32	...	Hazy	...	...	...	...	...	...	Threatening.	
Summit	1.00 p. m.	23.639	75	41	41	39	S.E.	40	8.00	...	Stratus	4-4	...	...	...	...	...	Cloudy—fog.	
Base...	...	26.94	56	54	54	51	S.E.	4	.08	...	Hazy	...	...	...	...	...	...	Threatening.	
Summit	2.00 p. m.	23.610	75	40	40	39	S.	42	8.82	...	Nimbus	4-4	S.E.	4-4	S.E.	...	...	Light rain.	
Base...	...	26.92	56	52	52	50	S.E.	4	.08	121	Nimbus	4-4	...	...	...	...	...	Heavy rain.	
Summit	3.00 p. m.	23.540	72	39	39	38	S.E.	44	11.52	...	Nimbus	4-4	...	...	...	...	...	Light rain.	
Base...	...	26.90	56	51	51	49	S.E.	6	.18	...	Nimbus	4-4	...	...	...	...	...	Light rain.	
Summit	4.00 p. m.	23.540	72	39	39	38	S.E.	54	14.58	...	Nimbus	4-4	...	...	...	...	...	Light rain.	
Base...	...	26.88	58	51	51	49	S.E.	14	.98	...	Nimbus	4-4	...	...	...	...	...	Light rain.	
Summit	4.57 p. m.	23.510	72	39	39	38	S.E.	60	18.00	...	Nimbus	4-4	...	...	1.30 p. m.	...	...	Heavy rain.	
Base...	...	26.84	58	51	51	49	S.E.	14	.98	...	Nimbus	4-4	...	...	1.55 p. m.	9.15 p. m.	.12	Heavy rain.	
Summit	6.00 p. m.	23.490	72	38	38	37	S.	65	21.12	...	Nimbus	4-4	...	...	...	...	...	Heavy rain.	
Base...	...	26.82	58	50	50	48	S.E.	12	.72	...	Nimbus	4-4	...	...	...	...	...	Heavy rain.	
Summit	9.00 p. m.	23.450	69	38	38	37	S.E.	66	21.78	...	Nimbus	4-4	...	...	...	...	...	Light rain.	
Base...	...	26.79	59	48	48	47	S.E.	5	.12	...	Nimbus	4-4	...	...	...	...	...	Light rain.	
Summit	11.57 p. m.	23.460	74	37	37	36	S.E.	52	13.52	...	Nimbus	4-4	...	...	11.15 p. m.	...	...	Light rain.	
Base...	...	26.77	58	46	46	46	Calm.	...	...	...	Nimbus	4-4	...	...	...	...	...	Light rain.	

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,982.5 feet. Height of barometer at summit above ground, 3 feet. Elevation of base above sea-level, 2,615 feet. Height of barometer at base above ground, 34 feet.

Meteorological record for May 20, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM.			HYGROM.		WIND.		LOWER CLOUDS.		UPPER CLOUDS.			RAIN OR SNOW.		Maximum and minimum ther- mometer.	Remarks.
			Attached.	Exposed.	Dry bulb.	Wet bulb.	Relative humid- ity.	Direction.	Velocity per hour.	Pressure per sq. ft.	Daily ve- locity.	Kind.	Amount.	Kind.	Amount.	Commenced.	Ended.	
Summit	6.00 a. m.	23.390	63	36	36	35	90	S. E.	60	18.00	...	Nimbus...	4-4	Hidden	...	...	...	Heavy rain.
Base	...	26.76	56	46	46	46	100	Calim.	...	...	...	Nimbus...	4-4	Hidden	...	...	...	Light rain.
Summit	7.00 a. m.	23.390	66	35	35	34	90	S. E.	66	21.75	...	Nimbus...	4-4	Hidden	...	...	...	Light rain.
Base	...	26.77	54	47	47	47	100	W.	4	08	...	Nimbus...	4-4	Hidden	...	...	...	Light rain.
Summit	7.57 a. m.	23.371	65	35	35	34	90	S. W.	60	18.00	...	Nimbus...	4-4	Hidden	...	...	...	Light rain.
Base	...	26.77	54	48	48	47	92	W.	4	03	...	Nimbus...	4-4	Hidden	...	...	...	Light rain.
Summit	8.00 a. m.	23.380	66	35	35	34	90	N. W.	54	14.58	...	Nimbus...	4-4	Hidden	...	...	...	Light rain.
Base	...	26.77	54	47	47	47	100	W.	6	18	...	Nimbus...	4-4	Hidden	...	...	...	Light rain.
Summit	10.00 a. m.	23.410	74	36	36	35	90	N. W.	54	14.58	...	Nimbus...	4-4	Hidden	...	...	...	Light rain.
Base	...	26.79	54	48	48	48	100	W.	6	18	...	Nimbus...	4-4	Hidden	...	...	...	Light rain.
Summit	11.00 a. m.	23.430	77	35	35	34	90	N. W.	50	12.50	...	Nimbus...	4-4	Hidden	...	...	...	Light rain.
Base	...	26.79	54	50	50	48	86	W.	5	12	...	Cumulus...	0	Hidden	...	...	...	Light rain.
Summit	12.00 m.	23.430	75	35	35	34	90	N. W.	48	11.52	...	Nimbus...	4-4	Hidden	...	...	...	Light rain.
Base	...	26.78	54	49	49	48	93	W.	4	03	...	Cumulus...	4-4	Hidden	...	...	...	Light rain.
Summit	1.00 p. m.	23.390	72	35	35	34	90	N. W.	48	11.52	...	Nimbus...	4-4	Hidden	...	...	...	Light rain.
Base	...	26.75	54	50	50	48	86	S. W.	4	03	...	Nimbus...	4-4	Hidden	...	...	...	Light rain.
Summit	2.00 p. m.	23.361	69	34	34	33	90	N. W.	63	23.12	133	Nimbus...	4-4	Hidden	...	...	...	Light rain.
Base	...	26.78	55	52	52	48	73	W.	6	18	...	Cumulus...	0	Hidden	...	...	...	Light rain.
Summit	3.00 p. m.	23.430	67	34	34	33	90	N. W.	64	23.12	...	Nimbus...	4-4	Hidden	...	...	...	Light rain.
Base	...	26.77	55	55	55	49	62	W.	10	50	...	Cumulus...	4-4	Hidden	...	...	...	Light rain.
Summit	4.00 p. m.	23.410	70	34	34	33	90	N. W.	44	11.52	...	Stratus...	3-4	Hidden	...	...	...	Light rain.
Base	...	26.77	55	54	54	49	67	W.	4	08	...	Cumulus...	4-4	Hidden	...	...	...	Light rain.
Summit	4.57 p. m.	23.426	72	36	36	35	90	N. W.	46	10.58	...	Stratus...	1-4	Hidden	...	...	...	Light rain.
Base	...	26.78	56	56	56	49	57	N. W.	8	32	...	Stratus...	2-4	Hidden	...	...	...	Light rain.
Summit	6.00 p. m.	23.470	74	35	35	34	90	N. W.	42	8.82	...	Stratus...	0	Hidden	...	...	...	Light rain.
Base	...	26.79	57	54	55	49	62	Calim.	42	8.82	...	Nimbus...	4-4	Hidden	...	...	...	Light rain.
Summit	9.00 p. m.	23.471	71	35	35	34	90	N. W.	42	8.82	...	Nimbus...	4-4	Hidden	...	...	...	Light rain.
Base	...	26.83	55	46	46	45	92	E.	4	08	...	Stratus...	4-4	Hidden	...	...	...	Light rain.
Summit	11.57 p. m.	23.470	71	34	34	33	90	N.	44	9.68	...	Stratus...	4-4	Hidden	...	...	...	Light rain.
Base	...	26.84	54	45	45	45	100	W.	4	08	...	Nimbus...	4-4	Hidden	...	...	...	Light rain.

* Not enough to measure.

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea level, 6,282.5 feet. Height of barometer at summit above ground, 3 feet.
 Elevation of base above sea level, 2,615 feet. Height of barometer at base above ground, 24 feet.

Meteorological record for May 21, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.			THERM.		HYGROM.		WIND.			LOWER CLOUDS.		UPPER CLOUDS.		RAIN OR SNOW.		Amount of rain or melted snow.	Max. in m. and min. in thermometer.	Remarks.
		Attached.	Exposed.	Relative humid- ity.	Direction.	Velocity per hour.	Pressure per sq. in.	Daily ve- locity.	Kind.	Amount.	Kind.	Amount.	Kind.	Amount.	Direction (moving from—)	Commenced.	Ended.			
Summit ...	6.00 a. m.	33.320	33	33	N. W.	42	2.3	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Heavy rain.
Base ...	...	26.91	34	43	W.	3	0.5	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Light rain.
Summit ...	7.00 a. m.	33.331	33	33	N. W.	42	2.3	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Heavy rain.
Base ...	...	26.91	34	44	N. W.	2	0.2	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Heavy rain.
Summit ...	7.57 a. m.	33.380	33	33	N. W.	42	2.3	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Heavy rain.
Base ...	...	26.93	33	33	Calm	...	...	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Heavy rain.
Summit ...	9.00 a. m.	33.610	33	34	N. W.	30	4.50	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Heavy rain.
Base ...	...	26.95	33	46	N. W.	...	...	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Light rain.
Summit ...	10.00 a. m.	33.640	35	35	N. W.	13	2.4	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Light rain.
Base ...	...	26.98	32	46	N. W.	...	...	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Light rain.
Summit ...	11.00 a. m.	33.671	35	35	N. W.	15	1.12	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Drizzling rain.
Base ...	...	26.99	32	49	N. W.	...	...	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Drizzling rain.
Summit ...	12.00 m.	33.671	33	36	N. W.	15	1.12	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Clearing.
Base ...	...	27.02	33	48	N. W.	...	...	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Clearing.
Summit ...	1.00 p. m.	33.675	33	35	N. W.	25	3.12	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Clearing.
Base ...	...	27.02	33	48	N. W.	4	0.8	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Clearing.
Summit ...	2.00 p. m.	33.680	33	35	N. W.	16	1.28	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Heavy rain.
Base ...	...	27.02	34	49	N. W.	4	0.8	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Heavy rain.
Summit ...	3.00 p. m.	33.681	35	35	N. W.	20	2.00	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Threatening.
Base ...	...	27.04	33	50	N. W.	4	0.8	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Threatening.
Summit ...	4.00 p. m.	33.684	33	34	N. W.	22	2.42	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Heavy rain.
Base ...	...	27.07	34	48	N. W.	4	0.8	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Cloudy.
Summit ...	4.57 p. m.	33.690	33	33	N. W.	31	5.78	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Drizzling rain.
Base ...	...	27.11	34	50	N. W.	4	0.8	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Threatening.
Summit ...	6.00 p. m.	33.740	32	32	N. W.	18	1.62	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Threatening.
Base ...	...	27.14	35	50	N. W.	...	...	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Threatening.
Summit ...	9.00 p. m.	33.730	30	31	N. W.	...	...	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Threatening.
Base ...	...	27.18	33	40	N. W.	...	...	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Fair.
Summit ...	11.57 p. m.	33.770	29	29	N. W.	4	0.3	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Fair.
Base ...	...	27.21	25	38	N.	4	0.8	...	Nimbus...	4.4	Hidden	...	...	...	...	...	...	...	...	Fair.

* Shower between 2 and 3 p. m.

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea level, 6,999.5 feet. Height of barometer at summit above ground, 3 feet. Elevation of base above sea level, 2,015 feet. Height of barometer at base above ground, 34 feet.

Meteorological record for May 22, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM.		HYGROM.	WIND.	LOWER CLOUDS.		UPPER CLOUDS.		RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.
			Attached.	Exposed.			Direction.	Velocity per sq. ft.	Pressure per sq. ft.	Direction. (moving from—)	Kind.	Amount.				Kind.	Amount.
Summit	6.00 a. m.	35.830	44	44	82	N. W.	7	25	0	0	0	0	0	0	Fair.
Base	6.00 a. m.	37.24	40	40	80	N. E.	4	4	0	0	0	0	0	0	Fair.
Summit	7.00 a. m.	35.840	47	47	80	N. W.	5	12	0	0	0	0	0	0	Fair.
Base	7.00 a. m.	37.25	44	44	84	Calm	0	0	0	0	0	0	0	0	Fair.
Summit	7.57 a. m.	35.830	46	46	80	N. W.	1	7	0	0	0	0	0	0	Fair.
Base	7.57 a. m.	37.27	43	43	84	Calm	0	0	0	0	0	0	0	0	Fair.
Summit	9.00 a. m.	35.880	54	54	82	N. W.	4	0	0	0	0	0	0	0	Fair.
Base	9.00 a. m.	37.26	48	48	80	N. W.	2	0	0	0	0	0	0	0	Fair.
Summit	10.00 a. m.	35.910	60	60	83	N. W.	6	0	0	0	0	0	0	0	Fair.
Base	10.00 a. m.	37.26	50	50	82	N. W.	4	2	0	0	0	0	0	0	Fair.
Summit	11.00 a. m.	35.925	63	63	84	N. W.	4	0	0	0	0	0	0	0	Fair.
Base	11.00 a. m.	37.28	52	52	84	N. W.	4	0	0	0	0	0	0	0	Fair.
Summit	12.00 m.	35.930	65	65	87	N. W.	3	0	0	0	0	0	0	0	Fair.
Base	12.00 m.	37.27	52	52	86	N. W.	3	0	0	0	0	0	0	0	Fair.
Summit	1.00 p. m.	35.950	66	66	88	N. W.	6	18	0	0	0	0	0	0	Fair.
Base	1.00 p. m.	37.25	54	54	85	N. W.	3	0	0	0	0	0	0	0	Fair.
Summit	2.00 p. m.	35.981	69	69	89	N. W.	3	0	0	0	0	0	0	0	Fair.
Base	2.00 p. m.	37.25	56	56	89	N. W.	3	0	0	0	0	0	0	0	Fair.
Summit	3.00 p. m.	35.930	70	70	89	N. W.	4	32	0	0	0	0	0	0	Fair.
Base	3.00 p. m.	37.25	59	59	89	N. W.	3	0	0	0	0	0	0	0	Fair.
Summit	4.00 p. m.	35.910	68	68	89	N. W.	5	12	0	0	0	0	0	0	Fair.
Base	4.00 p. m.	37.24	58	58	89	N. W.	4	0	0	0	0	0	0	0	Fair.
Summit	4.57 p. m.	35.900	68	68	89	N. W.	7	25	0	0	0	0	0	0	Fair.
Base	4.57 p. m.	37.23	58	58	88	N. W.	10	12	0	0	0	0	0	0	Fair.
Summit	6.00 p. m.	35.930	72	72	88	N. W.	10	50	0	0	0	0	0	0	Cloudy.
Base	6.00 p. m.	37.23	60	60	85	N. W.	6	18	0	0	0	0	0	0	Cloudy and fog.
Summit	9.00 p. m.	35.860	65	65	85	N. W.	27	6	0	0	0	0	0	0	Cloudy.
Base	9.00 p. m.	37.22	57	57	85	N. W.	42	8	0	0	0	0	0	0	Cloudy.
Summit	11.57 p. m.	35.821	65	65	84	N. W.	42	39	0	0	0	0	0	0	Threatening.
Base	11.57 p. m.	37.12	56	56	84	N. W.	9	40	0	0	0	0	0	0	Threatening.

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,282.5 feet. Height of barometer at summit above ground, 3 feet. Elevation of base above sea-level, 2,615 feet. Height of barometer at base above ground, 24 feet.

Meteorological record for May 23, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM.		HYGROM.	Relative humid- ity.	WIND.		LOWER CLOUDS.		UPPER CLOUDS.		RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.
			Attached.	Exposed.			Dry bulb.	Wet bulb.	Direction.	Velocity per sq. ft. per hour.	Kind.	Amount.	Kind.	Amount (moving from—)				Commentd.	Ended.
Summit	6.00 a.m.	23.625	53	32	32	100	S.	66	21.78	Nimbus...	4.4	Hidden...					Heavy rain.
Base...	6.00 a.m.	27.02	53	45	46	84	S. E.	16	1.28	Nimbus...	4.4	Hidden...					Heavy rain.
Summit	7.00 a.m.	23.609	39	32	32	100	S.	66	21.78	Nimbus...	4.4	Hidden...					Heavy rain.
Base...	7.00 a.m.	27.01	32	46	47	85	S. E.	14	1.02	Nimbus...	4.4	Hidden...					Heavy rain.
Summit	7.57 a.m.	23.609	36	34	34	90	S. W.	72	23.92	Nimbus...	4.4	Hidden...					Heavy rain.
Base...	7.57 a.m.	27.00	33	48	48	85	S. E.	30	2.00	Nimbus...	4.4	Hidden...			.09		Heavy rain.
Summit	9.00 a.m.	23.638	67	35	35	40	S. W.	66	21.78	Nimbus...	4.4	Hidden...					Heavy rain.
Base...	9.00 a.m.	27.00	33	49	49	85	S. E.	30	2.00	Nimbus...	4.4	Hidden...					Heavy rain.
Summit	10.00 a.m.	23.660	64	37	37	90	S. W.	54	14.58	Nimbus...	4.4	Hidden...					Light rain.
Base...	10.00 a.m.	26.99	52	51	51	49	S. E.	30	2.00	Nimbus...	4.4	Hidden...					Light rain.
Summit	11.00 a.m.	23.690	77	39	39	84	S. W.	48	11.52	Nimbus...	4.4	Hidden...					Drizzling rain.
Base...	11.00 a.m.	26.98	53	53	53	80	S. E.	18	1.28	Nimbus...	4.4	Hidden...					Drizzling rain.
Summit	12.00 m.	23.710	77	38	38	90	S. E.	18	1.32	Nimbus...	4.4	Hidden...					Light rain.
Base...	12.00 m.	26.99	54	51	51	49	S. E.	17	1.44	Nimbus...	4.4	Cirrus...	1.4	W.			Drizzling rain.
Summit	1.00 p.m.	23.690	75	42	42	91	N. W.	17	1.44	Stratus...	4.4	Hidden...					Drizzling rain.
Base...	1.00 p.m.	26.98	54	52	52	86	S. E.	4	0.08	Stratus...	4.4	Hidden...					Threatening.
Summit	2.00 p.m.	23.679	73	39	39	87	N. W.	15	1.12	Stratus...	4.4	Hidden...					Threatening.
Base...	2.00 p.m.	26.96	56	55	55	87	N. W.	4	0.08	Stratus...	4.4	Cumulus...	4.4	0			Clearing up.
Summit	3.00 p.m.	23.640	73	44	44	92	N. W.	20	2.00	Stratus...	0	Hidden...					Cloudy.
Base...	3.00 p.m.	26.97	58	54	54	87	W.	2	0.02	Stratus...	4.4	Hidden...					Threatening.
Summit	4.00 p.m.	23.691	73	44	44	92	N.	36	3.32	Nimbus...	4.4	Hidden...					Cloudy.
Base...	4.00 p.m.	26.98	58	53	53	51	86	Caln.	34	2.88	Stratus...	4.4	Hidden...				Heavy rain.
Summit	4.57 p.m.	23.640	72	44	44	92	N. W.	34	2.88	Stratus...	4.4	Hidden...					Cloudy.
Base...	4.57 p.m.	26.98	57	52	52	51	93	Caln.	30	4.50	Nimbus...	4.4	Hidden...			.17	Light rain.
Summit	6.00 p.m.	23.690	74	44	44	92	N. W.	30	4.50	Nimbus...	4.4	Hidden...			.09		Light rain.
Base...	6.00 p.m.	26.98	58	51	51	100	E.	1	0.01	Nimbus...	4.4	Hidden...					Light rain.
Summit	9.00 p.m.	23.680	74	42	42	41	91	N. W.	40	8.00	Nimbus...	4.4	Hidden...				Drizzling rain.
Base...	9.00 p.m.	27.03	60	50	50	49	93	Caln.	58	16.82	Fog...	Hidden...					Drizzling rain.
Summit	11.57 p.m.	23.700	68	39	39	91	N. W.	58	16.82	Nimbus...	4.4	Hidden...			.14		Dense fog.
Base...	11.57 p.m.	27.05	60	50	50	100	Caln.	58	16.82	Fog...		Hidden...			.44-31		Foggy.

* Shower between 3 and 4 p. m.
Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,292.5 feet. Height of barometer at summit above ground, 3 feet. Elevation of base above sea-level, 2,615 feet. Height of barometer at base above ground, 94 feet.

Meteorological record for May 24, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.		THERM.		HYGROM.		WIND.			LOWER CLOUDS.		UPPER CLOUDS.			RAIN OR SNOW.		Maximum and minimum ther- mometer.	Remarks.
Summit	6.00 a.m.	23.760	64	36	34	80	Calm.	5	.12	N.	0	Cumulus.	2-4	N.	Dur. night 3 a.m.				Fair. Light rain.
Base...		27.10	58	45	45	100	Calm.	5	.12	N.	0	Hidden	2-4	N.					Drizzling.
Summit	7.00 a.m.	23.770	65	38	36	80	N.W.	4	.08	N.W.	0	Cumulus.	2-4	N.					Drizzling.
Base...		27.11	55	50	50	48	N.W.	4	.08	N.W.	0	Hidden	2-4	N.					Threatening.
Summit	7.57 a.m.	23.780	65	40	45	38	N.W.	4	.08	N.W.	0	Cumulus.	2-4	N.					Fair.
Base...		27.12	57	46	46	100	W.	4	.08	W.	0	Hidden	2-4	N.	7.20 a.m.				Drizzling.
Summit	9.00 a.m.	23.790	66	44	44	92	W.	5	.12	W.	0	Hazy	3-4	N.					Clouds above and below summit.
Base...		27.13	52	46	46	100	W.	2	.02	W.	0	Hidden	3-4	N.					Threatening—heavy mist.
Summit	10.00 a.m.	23.800	65	45	45	84	Calm.				0	Cumulus.	3-4	0					Clouds above and below summit.
Base...		27.14	56	47	47	100	Calm.				0	Hidden	3-4	W.					Threatening—heavy mist.
Summit	11.00 a.m.	23.800	64	45	45	42	W.	2	.02	W.	0	Cirro-cum.	3-4	W.					Clouds above and below summit.
Base...		27.13	55	48	48	100	Calm.				0	Hidden	3-4	W.					Drizzling.
Summit	12.00 m.	23.800	67	47	47	44	W.	6	.18	W.	0	Cirro-cum.	3-4	W.					Clouds above and below summit.
Base...		27.11	56	53	53	51	Calm.				0	Hidden	3-4	S.W.					Clearing.
Summit	1.00 p.m.	23.800	68	48	48	45	S.W.	7	.25	S.W.	0	Cirro-cum.	3-4	S.W.					Clouds above and below summit.
Base...		27.10	57	60	59	55	S.W.	4	.08	S.W.	0	Cumulus.	3-4	S.E.					Fair.
Summit	2.00 p.m.	23.802	73	46	46	44	S.W.	8	.32	S.W.	0	Hidden	4-4	S.E.					Cloudy.
Base...		27.10	59	60	59	55	W.	2	.02	W.	0	Cumulus.	4-4	S.E.					Dense clouds on summit.
Summit	3.00 p.m.	23.800	73	45	45	44	W.	15	1.12	W.	0	Hidden	3-4	S.E.					Cloudy.
Base...		27.10	60	60	60	56	W.	6	.18	W.	0	Cumulus.	3-4	S.E.					Cloudy.
Summit	4.00 p.m.	23.800	72	45	45	43	N.W.	6	.18	N.W.	0	Hidden	4-4	N.W.					Cloudy.
Base...		27.10	61	61	61	56	W.	4	.08	W.	0	Cumulus.	4-4	N.W.					Cloudy.
Summit	4.57 p.m.	23.800	62	62	61	56	W.	16	1.28	W.	0	Cumulus.	4-4	0					Cloudy.
Base...		27.09	62	62	61	56	W.	15	1.12	W.	0	Hidden	3-4	0	(*)				Cloudy, and over summit.
Summit	6.00 p.m.	23.800	71	44	44	43	W.	15	1.12	W.	0	Cumulus.	4-4	0					Cloudy.
Base...		27.10	61	58	58	54	W.	4	.08	W.	0	Cumulus.	4-4	0					Fair.
Summit	9.00 p.m.	23.780	72	40	40	39	N.W.	32	5.12	N.W.	0	Cumulus.	1-4	0					Fair.
Base...		27.10	59	53	53	51	N.W.	3	.04	N.W.	0	Hidden	1-4	0					Fair.
Summit	11.57 p.m.	23.760	70	48	48	41	N.W.	48	11.52	N.W.	0	Cumulus.	1-4						Fair.
Base...		27.10	60	51	51	50	Calm.				0	Hidden	1-4						Fair.

* Drizzling during a.m.

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,282.5 feet. Height of barometer at summit above ground, 3 feet. Elevation of base above sea-level, 2,615 feet. Height of barometer at base above ground, 24 feet.

Meteorological record for May 25, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM. HYGROM.		WIND.		LOWER CLOUDS.		UPPER CLOUDS.		RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.					
			Attached.	Exposed.	Dry bulb.	Wet bulb.	Relative humidity.	Direction.	Velocity.	Per hour.	Daily ve- locity.	Locality.				Kind.	Amount.	Kind.	Amount.	Direction. (moving from—)	Comment.	Ended.
Summit	6.00 a.m.	23.710	66	44	43	92	W.	50	12.50		Nimbus.	4.4	Hidden.							Light rain. Cloudy.
Base...	27.07	59	53	54	93	Stratus	3	0.05			Stratus	4.4	Hidden.							
Summit	7.00 a.m.	27.750	63	44	44	92	N.W.	48	11.32		Stratus	4.4	Hidden.							
Base...	27.05	60	57	57	92	Cal.					Stratus	4.4	Hidden.							
Summit	7.57 a.m.	27.750	64	44	43	92	W.	42	2.32		Stratus	4.4	Hidden.							
Base...	27.05	61	60	60	76	W.	42	8.26			Stratus	4.4	Hidden.							
Summit	9.00 a.m.	27.710	63	44	44	92	W.	42	8.26		Stratus	4.4	Hidden.							
Base...	27.05	63	60	60	76	W.	38	7.22			Stratus	4.4	Hidden.							
Summit	10.00 a.m.	27.725	71	44	44	92	W.	46	11.32		Stratus	4.4	Hidden.							
Base...	27.05	63	61	61	56	71	W.	46	11.32		Stratus	4.4	Hidden.							
Summit	11.00 a.m.	27.065	63	64	63	67	S.W.	45	10.12		Stratus	4.4	Hidden.							
Base...	27.725	70	63	63	66	66	W.	45	10.12		Stratus	4.4	Hidden.							
Summit	12.00 m.	27.055	63	63	62	66	W.	42	8.26		Stratus	4.4	Hidden.							
Base...	27.055	70	63	63	66	66	W.	42	8.26		Stratus	4.4	Hidden.							
Summit	1.00 p.m.	27.715	62	62	63	61	W.	48	11.32		Stratus	4.4	Hidden.							
Base...	27.04	62	62	62	63	61	W.	48	11.32		Stratus	4.4	Hidden.							
Summit	2.00 p.m.	27.710	62	62	62	61	S.	6	1.18	63	Hazy	0								
Base...	27.03	62	62	62	62	61	S.	6	1.18		Hazy	0								
Summit	3.00 p.m.	27.715	75	43	43	91	S.W.	36	6.48		Stratus	4.4	Hidden.							
Base...	27.01	64	63	63	62	62	S.W.	36	6.48		Stratus	4.4	Hidden.							
Summit	4.00 p.m.	27.715	76	43	43	92	S.W.	36	6.48		Stratus	4.4	Hidden.							
Base...	27.02	64	62	62	63	61	S.W.	36	6.48		Stratus	4.4	Hidden.							
Summit	4.57 p.m.	23.699	75	42	42	91	S.W.	36	6.48		Stratus	4.4	Hidden.							
Base...	27.02	64	60	60	51	49	S.W.	36	6.48		Stratus	4.4	Hidden.							
Summit	6.00 p.m.	23.685	75	41	41	89	S.W.	40	8.00		Stratus	4.4	Hidden.							
Base...	27.03	65	60	60	51	49	S.W.	40	8.00		Stratus	4.4	Hidden.							
Summit	9.00 p.m.	27.680	75	35	35	89	N.W.	54	14.56		Stratus	4.4	Hidden.							
Base...	27.06	60	49	49	45	64	N.W.	4	0.06		Stratus	4.4	Hidden.							
Summit	11.57 p.m.	23.610	31	31	30	89	N.W.	74	27.36		Stratus	4.4	Hidden.							
Base...	27.10	58	45	45	45	68	N.W.	4	0		Stratus	4.4	Hidden.							

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,288.5 feet. Height of barometer at summit above ground, 3 feet. Elevation of base above sea-level, 2,615 feet. Height of barometer at base above ground, 34 feet.

Meteorological record for May 26, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.		THERM.		HYGROM.		WIND.		LOWER CLOUDS.		UPPER CLOUDS.		RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.
		Attached.	Exposed.	Dry bulb.	Wet bulb.	Relative humid- ity.	Direction.	Velocity per hour.	Pressure per sq. ft.	Daily ve- locity.	Kind.	Amount.	Kind.	Amount (moving from—)	Commented.	Ended.		
Summit	6.00 a.m.	23.600	28	28	27	82	N. W.	68	23.12		Nimbus...	4.4	Hidden					Heavy snow.
Base...		27.15	54	42	42	82	W.	6	18		Stratus...	4.4	Hidden					Cloudy.
Summit	7.00 a.m.	23.609	28	29	27	89	N. W.	63	21.12		Stratus...	4.4	Hidden			6.30 a.m.		Clearing up.
Base...		27.16	53	43	41	83	W.	6	18		Stratus...	4.4	Hidden					Cloudy.
Summit	7.57 a.m.	23.630	28	29	28	89	N. W.	63	19.22		Stratus...	4.4	Hidden				.06	Clearing up.
Base...		27.16	52	43	44	76	W.	5	12		Stratus...	4.4	Hidden					Cloudy.
Summit	9.00 a.m.	23.680	32	30	28	78	N. W.	50	17.40		Stratus...	1.4	Cirro-cum.	3.4	N. W.			Dense clouds above and below summit.
Base...		27.16	53	48	44	70	E.	2	02		Cumulus...	0	Cumulus...	3.4	N.			Fair.
Summit	10.00 a.m.	27.758	31	51	50	79	N.	40	8.00		Hazy...	0	Cirrus...	1.4	N.			Fair.
Base...		27.18	53	51	45	59	W.	4	08		Hazy...	0	Cirrus...	1.4	0			Fair.
Summit	11.00 a.m.	23.740	32	54	46	69	N. W.	42	8.82		Hazy...	0	Cirrus...	1.4	N. W.			Fair.
Base...		27.19	54	54	46	49	W.	6	18		Hazy...	0	Cirrus...	1.4	N. W.			Fair.
Summit	12.00 m.	23.820	33	56	48	69	N. W.	48	11.52		Hazy...	0	Cirrus...	1.4	N. W.			Fair.
Base...		27.22	59	56	48	51	S. W.	6	18		Hazy...	0	Cirrus...	1.8	N. W.			Fair.
Summit	1.00 p.m.	23.860	35	58	48	70	N.	30	2.00		Hazy...	0	Cirrus...	1.4	N.			Fair.
Base...		27.21	59	58	48	42	W.	5	12		Hazy...	0	Cirrus...	0	0			Clear.
Summit	2.00 p.m.	23.870	36	58	36	61	N.	6	18	139	Hazy...	0	Cirrus...	1.4	N.			Fair.
Base...		27.21	59	61	37	33	W.	6	18		Hazy...	0	Cirrus...	0	0			Clear.
Summit	3.00 p.m.	23.880	37	37	33	62	N.	4	08		Hazy...	0	Cirrus...	2.4	N. W.			Fair.
Base...		27.21	60	64	63	52	W.	4	08		Hazy...	0	Cirrus...	1.4	N. W.			Fair.
Summit	4.00 p.m.	23.874	39	39	36	71	N. W.	12	72		Hazy...	0	Cirrus...	2.4	N. W.			Fair.
Base...		27.21	62	63	33	51	W.	6	18		Hazy...	0	Cirrus...	4.4	0			Cloudy.
Summit	4.57 p.m.	23.865	57	40	37	73	N. W.	13	6	18		0	Cirrus...	4.4	N. W.			Fair.
Base...		27.21	61	62	62	51	W.	6	18		0	0	Cirrus...	4.4	0			Cloudy.
Summit	6.00 p.m.	23.870	62	40	40	36	N.	5	12		Hazy...	0	Cirrus...	4.4	N.			Fair.
Base...		27.22	59	59	50	53	W.	1	01		Clear	0	Cirrus...	4.4	0			Cloudy.
Summit	9.00 p.m.	23.918	69	38	38	63	N. W.	5	12		0	0	Cirrus...	1.4	N. W.			Fair.
Base...		27.23	58	49	45	71	W.	2	02		0	0	Cirrus...	0	0			Clear.
Summit	11.57 p.m.	27.805	34	38	34	54	N. W.	13	8.4		0	0	Cirrus...	1.4	N. W.			Fair.
Base...		27.23	59	46	44	84	W.	4	08		0	0	Cirrus...	0	0			Clear.

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea level, 6,292.5 feet. Height of barometer at summit above the ground, 3 feet. Elevation of base above sea level, 2,615 feet. Height of barometer at base above the ground, 34 feet.

Meteorological record for May 27, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM.			HYGROM.			WIND.			LOWER CLOUDS.		UPPER CLOUDS.			RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.
			Attached.	Exposed.	Dry bulb.	Wet bulb.	Relative humid- ity.	Direction.	Velocity per hour.	Pressure per sq. ft.	Daily ve- locity.	Kind.	Amount.	Kind.	Amount.	Direction (moving from—)	Comment.	Ended.			
Summit	6.00 a. m.	23.850	57	36	36	39	61	S.W.	61	.72	...	Hazy	0	Cirro-cum.	24	S.W.	...	...	...	...	Fair.
Base	6.00 a. m.	27.16	47	37	47	43	70	E.	18	1.02	...	Hazy	0	Cirro-cum.	0	S.W.	...	...	...	...	Clear.
Summit	7.00 a. m.	23.830	58	38	38	34	63	S.W.	16	1.63	...	...	0	Cirro-cum.	0	S.W.	...	...	...	...	Fair.
Base	7.00 a. m.	27.15	54	39	39	35	61	S.W.	4	1.03	...	...	0	Cirro-cum.	0	S.W.	...	...	...	...	Clear.
Summit	7.57 a. m.	23.810	59	39	39	30	67	S.W.	96	3.38	...	...	0	Cirro-cum.	0	S.W.	...	...	...	...	Fair.
Base	7.57 a. m.	27.14	55	39	39	40	47	S.	8	3.39	...	...	0	Cirro-cum.	14	0	...	...	...	...	Fair.
Summit	9.00 a. m.	23.835	65	40	40	36	63	S.W.	39	5.12	...	...	0	Cumulus	24	S.W.	...	...	...	...	Fair.
Base	9.00 a. m.	27.13	56	40	40	59	43	S.	10	5.12	...	...	0	Cumulus	14	0	...	...	...	...	Fair.
Summit	10.00 a. m.	23.820	70	43	43	46	38	S.W.	35	6.12	...	...	0	Cirro-cum.	14	0	...	...	...	...	Fair.
Base	10.00 a. m.	27.12	58	43	43	60	44	E.	30	6.12	...	...	0	Cirro-cum.	14	0	...	...	...	...	Fair.
Summit	11.00 a. m.	23.830	75	45	45	40	75	S.W.	30	4.50	...	...	0	Cirro-cum.	14	0	...	...	...	...	Fair.
Base	11.00 a. m.	27.11	57	43	43	60	41	S.W.	35	6.12	...	...	0	Cirro-cum.	14	0	...	...	...	...	Fair.
Summit	12.00 m.	23.770	77	43	43	40	75	E.	35	6.12	...	...	0	Cumulus	24	S.E.	...	...	...	...	Fair.
Base	12.00 m.	27.09	59	43	43	63	42	E.	35	6.12	...	...	0	Cumulus	24	S.E.	...	...	...	...	Fair.
Summit	1.00 p. m.	23.780	73	43	43	38	67	S.	12	6.12	...	...	0	Cirro-cum.	24	0	...	...	...	...	Fair.
Base	1.00 p. m.	27.06	60	45	45	63	39	S.	12	6.12	...	...	0	Cumulus	34	0	...	...	...	...	Fair.
Summit	2.00 p. m.	23.740	74	44	44	39	59	S.	14	9.96	...	Hazy	0	Cumulus	34	0	...	...	...	...	Fair.
Base	2.00 p. m.	27.06	63	43	43	63	47	S.	14	9.96	...	...	0	Cumulus	34	0	...	...	...	...	Fair.
Summit	3.00 p. m.	23.730	69	43	43	35	75	S.	35	6.12	...	...	4.4	Hidden	4.4	S.E.	...	...	...	...	Cloudy.
Base	3.00 p. m.	27.03	63	42	42	62	53	S.E.	35	6.12	...	...	4.4	Hidden	4.4	S.E.	...	...	...	...	Cloudy.
Summit	4.00 p. m.	23.710	68	44	44	39	57	E.	10	11.52	...	...	0	Cumulus	24	S.E.	...	...	...	...	Fair.
Base	4.00 p. m.	27.04	62	44	44	38	61	E.	12	7.2	...	...	0	Cumulus	24	S.E.	...	...	...	...	Fair.
Summit	4.57 p. m.	23.710	68	38	38	36	81	S.E.	38	7.22	...	...	0	Cumulus	4.4	0	...	...	...	...	Cloudy.
Base	4.57 p. m.	27.03	63	41	41	61	53	E.	10	11.52	...	...	4.4	Hidden	4.4	0	...	...	...	...	Cloudy.
Summit	6.00 p. m.	23.710	71	57	57	37	59	S.W.	13	7.2	...	...	4.4	Hidden	4.4	0	...	...	...	...	Threatening.
Base	6.00 p. m.	27.04	59	57	57	49	52	E.	13	7.2	...	...	4.4	Hidden	4.4	0	...	...	...	...	Foggy.
Summit	9.00 p. m.	23.681	68	36	36	35	90	S.W.	12	19.22	...	...	4.4	Hidden	4.4	0	...	...	...	...	Threatening.
Base	9.00 p. m.	27.04	58	50	50	56	46	E.	12	7.2	...	...	4.4	Hidden	4.4	0	...	...	...	...	Heavy rain.
Summit	11.57 p. m.	23.629	69	35	35	35	34	S.W.	4	9.08	...	...	4.4	Hidden	4.4	0	...	...	...	...	Threatening.
Base	11.57 p. m.	27.02	59	47	47	45	85	E.	6	19	...	...	4.4	Hidden	4.4	0	...	...	...	...	Threatening.

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,282.5 feet. Height of barometer at summit above the ground, 3 feet. Elevation of base above sea-level, 9,615 feet. Height of barometer at base above the ground, 44 feet.

Meteorological record for May 28, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM.		HYGROM.		WIND.			LOWER CLOUDS.		UPPER CLOUDS.			RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.
			Attached.	Exposed.	Dry bulb.	Wet bulb.	Relative humid- ity.	Direction.	Velocity per hour.	Pressure per sq. ft.	Daily ve- locity.	Kind.	Amount.	Kind.	Direction (moving from—)	Commented.	Ended.		
Summit	6.00 a. m.	32.580	58	30	30	30	100	S. W.	16	1.98	...	Nimbus...	4.4	Hidden...	...	...	...	...	Heavy snow.
Base	...	32.96	54	42	42	42	100	S. W.	4	0.8	...	Hidden...	4.4	Hidden...	...	...	...	...	Threatening.
Summit	7.00 a. m.	32.800	50	31	31	30	99	S. W.	14	0.8	...	Nimbus...	4.4	Hidden...	...	...	...	...	Light rain.
Base	...	32.96	53	44	44	44	84	S. W.	12	0.8	...	Nimbus...	4.4	Hidden...	...	...	...	...	Light rain.
Summit	7.57 a. m.	32.600	53	31	30	30	99	S. W.	12	0.8	...	Nimbus...	4.4	Hidden...	...	...	...	...	Clearing.
Base	...	32.96	53	46	46	46	77	S. W.	12	0.8	...	Nimbus...	4.4	Hidden...	...	...	...	...	Heavy snow.
Summit	9.00 a. m.	32.610	69	31	30	30	89	W.	12	0.8	...	Nimbus...	4.4	Hidden...	...	...	...	...	Clearing.
Base	...	32.95	53	45	45	44	82	Calm	...	...	...	Nimbus...	4.4	Hidden...	...	...	...	...	Heavy snow.
Summit	10.00 a. m.	32.620	69	32	31	31	89	N. W.	10	0.8	...	Nimbus...	4.4	Hidden...	...	...	...	...	Clearing.
Base	...	32.95	52	47	47	45	85	W.	4	0.8	...	Nimbus...	4.4	Hidden...	...	...	...	...	Drizzling rain.
Summit	11.00 a. m.	32.640	68	33	33	32	89	W.	12	0.8	...	Nimbus...	4.4	Hidden...	...	...	...	...	Clearing.
Base	...	32.96	53	48	48	45	78	Calm	...	...	...	Nimbus...	4.4	Hidden...	...	...	...	...	Drizzling rain.
Summit	12.00 m.	32.630	67	33	33	31	79	W.	18	1.02	...	Nimbus...	4.4	Hidden...	...	...	...	...	Light snow.
Base	...	32.97	53	48	48	46	85	W.	4	0.8	...	Nimbus...	4.4	Hidden...	...	...	...	...	Drizzling rain.
Summit	1.00 p. m.	32.639	68	33	33	31	79	W.	22	2.42	...	Nimbus...	4.4	Hidden...	...	...	...	...	Threatening.
Base	...	32.97	54	49	49	47	85	W.	4	0.8	...	Nimbus...	4.4	Hidden...	...	...	...	...	Drizzling rain.
Summit	2.00 p. m.	32.630	70	34	34	33	79	W.	32	5.13	...	Nimbus...	4.4	Hidden...	...	...	...	...	Threatening.
Base	...	32.97	54	51	51	48	79	W.	8	3.32	183	Nimbus...	4.4	Hidden...	...	...	...	...	Clearing.
Summit	3.00 p. m.	32.670	75	35	35	33	90	W.	34	2.88	...	Nimbus...	4.4	Hidden...	...	...	...	...	Threatening.
Base	...	32.97	54	51	51	48	79	W.	34	2.88	...	Nimbus...	4.4	Hidden...	...	...	...	...	Threatening.
Summit	4.00 p. m.	32.672	76	35	35	33	90	S. W.	20	2.00	...	Nimbus...	4.4	Hidden...	...	...	...	...	Clearing.
Base	...	32.99	56	52	52	49	79	S. W.	18	1.01	...	Nimbus...	4.4	Hidden...	...	...	...	...	Threatening.
Summit	4.57 p. m.	32.672	76	35	35	33	90	W.	18	1.05	...	Nimbus...	4.4	Hidden...	...	...	...	...	Threatening.
Base	...	32.97	56	53	53	49	73	W.	3	0.95	...	Nimbus...	4.4	Hidden...	...	...	...	...	Heavy rain.
Summit	6.00 p. m.	32.690	76	35	35	33	90	N. W.	15	1.13	...	Nimbus...	4.4	Hidden...	...	...	...	...	Light snow.
Base	...	32.97	56	50	50	47	79	Calm	...	...	...	Nimbus...	4.4	Hidden...	...	...	...	...	Light rain.
Summit	9.00 p. m.	32.660	71	32	32	31	89	N. W.	42	8.92	...	Nimbus...	4.4	Hidden...	...	...	...	...	...
Base	...	32.95	54	43	43	43	100	Calm	...	...	...	Nimbus...	4.4	Hidden...	...	...	...	...	...
Summit	11.57 p. m.	32.650	67	29	29	28	89	N. W.	24	2.88	...	Nimbus...	4.4	Hidden...	...	...	...	...	...
Base	...	32.95	54	38	38	38	100	S. W.	4	0.8	...	Nimbus...	4.4	Hidden...	...	...	...	...	...

* Commenced about 2 a. m.

† Showers during day.

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,292.5 feet. Height of barometer at summit above the ground, 3 feet. Elevation of base above sea-level, 2,615 feet. Height of barometer at base above the ground, 24 feet.

*Meteorological record for May 29, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM.		HYGROM.	WIND.	LOWER CLOUDS.		UPPER CLOUDS.		RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.			
			Attached.	Exposed.			Dry bulb.	Wet bulb.	Relative humid- ity.	Direction.	Velocity per hour.	Pressure per sq. ft.				Daily ve- locity.	Kind.	Amount.	Kind.	Amount. (moving from—)	Commen'd.	Ended.
Summit	6.00 a. m.	23.600	50	26	96	25	29	96	W.	48	11.52	Stratus	4.4	Hidden	...	...	...	Cloudy.
Base ...	7.13	27.13	50	40	25	31	30	91	W.	4	...	Nimbus	4.4	Hidden	...	...	...	Threatening
Summit	7.00 a. m.	23.650	51	26	98	26	28	98	N.W.	38	7.22	Stratus	4.4	Hidden	...	...	...	Cloudy.
Base ...	7.14	27.14	51	41	91	30	30	91	Calm	...	...	Nimbus	4.4	Hidden	...	...	...	Cloudy.
Summit	7.57 a. m.	23.681	52	27	97	27	26	98	N.W.	35	6.12	Stratus	4.4	Hidden	...	...	...	Cloudy.
Base ...	7.14	27.14	48	28	88	33	33	83	Calm	...	...	Nimbus	3.4	Hidden	...	...	...	Cloudy.
Summit	9.00 a. m.	23.700	56	28	97	28	27	98	N.W.	32	5.12	Stratus	4.4	Hidden	...	...	...	Cloudy.
Base ...	7.14	27.14	49	29	89	33	33	83	W.	2	...	Nimbus	3.4	Hidden	...	...	...	Cloudy.
Summit	10.00 a. m.	23.740	63	29	99	29	28	99	N.W.	28	3.92	Stratus	4.4	Hidden	...	...	...	Cloudy.
Base ...	7.15	27.15	48	41	41	41	41	91	S.	4	...	Nimbus	4.4	Hidden	...	...	...	Cloudy.
Summit	11.00 a. m.	23.728	62	30	30	29	29	89	N.W.	28	3.92	Stratus	4.4	Hidden	...	...	...	Cloudy.
Base ...	7.15	27.15	49	42	42	41	41	91	Calm	...	...	Nimbus	3.4	Hidden	...	...	...	Cloudy.
Summit	12.00 m.	23.728	62	29	29	28	28	89	N.W.	41	8.40	Stratus	4.4	Hidden	...	...	...	Cloudy.
Base ...	7.15	27.15	48	43	43	42	42	92	Calm	...	...	Nimbus	4.4	Hidden	...	...	...	Cloudy.
Summit	1.00 p. m.	23.730	63	31	31	30	30	89	N.W.	38	7.22	Stratus	4.4	Hidden	...	...	...	Cloudy.
Base ...	7.16	27.16	48	42	42	41	41	91	W.	4	...	Nimbus	4.4	Hidden	...	...	...	Cloudy.
Summit	2.00 p. m.	23.721	70	31	31	30	30	89	N.W.	45	10.12	Stratus	4.4	Hidden	...	...	...	Cloudy.
Base ...	7.17	27.17	49	43	43	43	43	92	Calm	...	...	Stratus	4.4	Hidden	...	...	...	Cloudy.
Summit	3.00 p. m.	23.750	71	31	31	30	30	89	N.W.	40	8.00	Stratus	4.4	Hidden	...	...	...	Cloudy.
Base ...	7.18	27.18	48	42	42	41	41	91	Calm	...	...	Nimbus	4.4	Hidden	...	...	...	Cloudy.
Summit	4.00 p. m.	23.770	74	31	31	30	30	89	N.W.	40	8.00	Stratus	4.4	Hidden	...	...	...	Light rain.
Base ...	7.19	27.19	48	41	41	41	41	100	W.	6	...	Nimbus	4.4	Hidden	...	...	...	Cloudy.
Summit	4.57 p. m.	23.798	70	31	31	30	30	89	N.W.	40	8.00	Dense fog	...	...	...	...	...	Cloudy.
Base ...	7.20	27.20	48	41	41	41	41	100	W.	6	...	Nimbus	4.4	Hidden	...	...	...	Steeling.
Summit	6.00 p. m.	23.768	71	30	29	29	29	89	N.W.	46	10.58	Stratus	4.4	Hidden	...	...	...	Drizzling.
Base ...	7.20	27.20	48	42	42	41	41	93	Calm	...	...	Nimbus	4.4	Hidden	...	...	...	Cloudy.
Summit	9.00 p. m.	23.738	65	28	28	27	27	83	N.W.	62	19.24	Stratus	4.4	Hidden	...	...	...	Steeling.
Base ...	7.23	27.23	48	40	40	40	40	100	W.	4	...	Nimbus	4.4	Hidden	...	...	...	Cloudy.
Summit	11.57 p. m.	23.838	64	28	28	27	27	97	N.W.	37	6.54	Stratus	4.4	Hidden	...	...	...	Cloudy.
Base ...	7.25	27.25	50	38	38	38	38	100	W.	4	...	Nimbus	4.4	Hidden	...	...	...	Cloudy.

* Showers during day.

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,282.5 feet. Height of barometer at summit above the ground, 3 feet. Elevation of base above sea-level, 2,015 feet. Height of barometer at base above the ground, 24 feet.

Meteorological record for May 30, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM.			HYGROM.		WIND.			LOWER CLOUDS.		UPPER CLOUDS.		RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.
			Attached.	Exposed.	Wet bulb.	Relative humid- ity.		Direction.	Velocity per hour.	Pressure per sq. ft.	Daily ve- locity.	Kind.	Amount.	Kind.	Amount.	Direction, (moving from—)	Commented.	Ended.	
Summit	6.00 a. m.	32.750	57	31	31	90	N. W.	41	8.40			Stratus	3-4	Cumulus	1-4	N. W.			Cloudy.
Base		37.97	48	41	41	100	Calm					Stratus	4-4	Hidden					Cloudy.
Summit	7.00 a. m.	32.770	56	31	31	80	N. W.	35	6.12			Stratus	1-4	Cumulus	2-4	N. W.			Fair and clearing fast.
Base		37.97	48	40	40	100	N. W.	35	6.12			Stratus	1-4	Hidden					Cloudy.
Summit	7.57 a. m.	32.790	53	31	31	80	N. W.	36	6.45			Stratus	0	Cumulus	3-4	N. W.			Fair.
Base		37.97	45	45	45	80	N. W.	15	1.12			Stratus	0	Cumulus	3-4	N. W.			Clearing.
Summit	9.00 a. m.	32.800	57	31	31	80	N. W.	15	1.12			Stratus	0	Cumulus	2-4	N. W.			Fair; clouds all below summit.
Base		37.97	48	46	46	82	Calm					Stratus	1-4	Hidden					Cloudy.
Summit	10.00 a. m.	32.800	63	32	32	31	82	S. W.	8	.32		Stratus	1-4	Cumulus	2-4	S.			Fair; clouds all below summit.
Base		37.31	49	44	44	43	61	S. W.	1	.01		Stratus	3-4	Hidden					Cloudy.
Summit	11.00 a. m.	32.800	68	35	35	31	61	S. W.	4	.08		Stratus	3-4	Cumulus	3-4	S. W.			Fair; clouds all below summit.
Base		37.35	49	50	50	47	79	S. E.	4	.08		Stratus	1-4	Cumulus	3-4	0			Cloudy.
Summit	12.00 m.	32.800	69	36	36	31	52	N. W.	1	.01		Dense haze	0	Razy	3-4	N. W.			Fair.
Base		37.38	50	54	54	49	57	N. W.	4	.06		Stratus	0	Hidden					Cloudy.
Summit	1.00 p. m.	32.820	70	36	36	33	70	S. W.	4	.06		Stratus	0	Cumulus	4-4	0			Clouds on and below summit.
Base		37.37	52	53	53	49	73	Calm		.02		Stratus	4-4	Hidden					Cloudy.
Summit	2.00 p. m.	32.830	74	36	36	34	80	S. W.	2	.02	54	Stratus	1-4	Cumulus	4-4	0			Dense clouds.
Base		37.36	53	55	55	50	68	N. W.	2	.02		Stratus	4-4	Hidden					Fair.
Summit	3.00 p. m.	32.850	74	36	36	34	80	N. W.	1	.01		Stratus	0	Cumulus	4-4	S. E.			Clouds on and below summit.
Base		37.36	55	55	55	50	68	N. W.	1	.01		Stratus	4-4	Hidden					Cloudy.
Summit	4.00 p. m.	32.923	75	36	36	35	90	S. W.	9	.40		Nimbus	4-4	Hidden					Threatening.
Base		37.26	53	52	52	49	79	Calm		.18		Nimbus	4-4	Hidden					Light rain.
Summit	4.57 p. m.	32.920	77	35	35	34	90	S. W.	6	.18		Nimbus	4-4	Hidden			4.10 p. m.	5.50 p. m.	Drizzling.
Base		37.25	53	50	50	49	93	Calm		.05		Nimbus	4-4	Hidden					Threatening.
Summit	6.00 p. m.	32.910	76	35	35	34	90	S.	3	.05		Stratus	4-4	Hidden					Cloudy.
Base		37.25	53	49	49	48	93	Calm		.84		Nimbus	4-4	Hidden					Light rain.
Summit	9.00 p. m.	32.874	71	34	34	33	90	S. E.	13	.84		Nimbus	4-4	Hidden					Drizzling rain.
Base		37.23	53	46	46	100	Calm					Nimbus	4-4	Hidden			6.40 p. m.		Heavy rain.
Summit	11.57 p. m.	32.830	65	34	34	33	90	S.	17	1.44		Nimbus	4-4	Hidden			4.00 p. m.		Light rain.
Base		37.20	55	45	45	45	100	Calm				Nimbus	4-4	Hidden					

Stations, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,225 feet. Height of barometer at summit above ground, 3 feet. Elevation of base above sea-level, 2,615 feet. Height of barometer at base above ground, 24 feet.

Meteorological record for May 31, 1872.

Place of observa- tion.	Time of observa- tion.	Barometer.	THERM. HYGROM.			WIND.				LOWER CLOUDS.		UPPER CLOUDS.		RAIN OR SNOW.		Amount of rain or melted snow.	Maximum and minimum ther- mometer.	Remarks.	
			Attached.	Exposed.	Dry bulb.	Wet bulb.	Relative humid- ity.	Direction.	Velocity per hour.	Pressure per sq. ft.	Daily ve- locity.	Kind.	Amount.	Kind.	Amount (moving from—)				Commented.	Ended.
Summit	6.00 a. m.	23.732	53	32	32	32	100	S.W.	39	7.60		Nimbus...	4.4	Hidden					Light snow.
Base	6.15	27.15	53	32	32	32	100	Calm				Nimbus...	4.4	Hidden					Heavy rain.
Summit	7.00 a. m.	23.750	53	32	32	32	100	S.W.	18	1.62		Nimbus...	4.4	Hidden					Light snow.
Base	7.15	27.15	53	32	32	32	100	Calm				Nimbus...	4.4	Hidden					Heavy rain.
Summit	7.57 a. m.	23.751	53	32	32	32	100	S.W.	14	.98		Nimbus...	4.4	Hidden					Light snow.
Base	7.15	27.15	52	32	32	32	78	Calm				Nimbus...	4.4	Hidden					Heavy rain.
Summit	9.00 a. m.	23.761	53	33	33	33	89	S.W.	14	.98		Nimbus...	4.4	Hidden					Light snow.
Base	9.14	27.14	52	33	33	33	85	Calm				Nimbus...	4.4	Hidden					Light rain.
Summit	10.00 a. m.	23.780	53	33	33	33	89	E.	24	2.88		Nimbus...	4.4	Hidden					Light snow.
Base	10.14	27.14	51	34	34	34	86	Calm				Nimbus...	4.4	Hidden					Light rain.
Summit	11.00 a. m.	23.771	54	34	34	34	90	S.W.	14	.98		Nimbus...	4.4	Hidden					Drizzling rain.
Base	11.14	27.14	51	48	48	48	100	W.	4	.08		Nimbus...	4.4	Hidden					Light rain.
Summit	12.00 m.	23.772	66	34	34	34	90	S.W.	15	1.12		Nimbus...	4.4	Hidden					Threatening.
Base	12.15	27.15	51	50	50	47	79	Calm				Nimbus...	4.4	Hidden					Light rain.
Summit	1.00 p. m.	23.772	68	33	33	33	89	W.	18	1.62		Nimbus...	4.4	Hidden					Light snow.
Base	1.14	27.14	51	50	50	48	86	S.	4	.08		Nimbus...	4.4	Hidden					Light rain.
Summit	2.00 p. m.	23.773	71	33	33	33	89	W.	33	5.44		Nimbus...	4.4	Hidden					Light snow.
Base	2.14	27.14	53	49	49	47	85	N.	2	.02	32	Nimbus...	4.4	Hidden					Threatening.
Summit	3.00 p. m.	23.780	69	34	34	34	93	N.W.	24	2.88		Nimbus...	4.4	Hidden					Threatening.
Base	3.14	27.14	53	49	49	48	93	Calm				Nimbus...	4.4	Hidden					Light rain.
Summit	4.00 p. m.	23.772	70	34	34	34	90	W.	30	4.50		Stratus...	4.4	Hidden					Slight indications of clearing.
Base	4.14	27.14	54	50	50	49	93	Calm				Nimbus...	4.4	Hidden					Threatening.
Summit	4.57 p. m.	23.790	71	34	34	33	90	W.	20	2.00		Stratus...	2.4	Heavy	12.10 p. m. 11.40 a. m.			.32	Clearing up.
Base	5.15	27.15	54	50	50	48	90	N.W.	4	.08		Nimbus...	1.4	Cumulus...	3.45 p. m. 2.30 p. m.			.08	Clearing up.
Summit	6.00 p. m.	23.811	70	34	34	34	90	N.E.	28	3.92		Stratus...	4.4	Hidden					Heavy snow.
Base	6.17	27.17	53	48	48	48	100	Calm				Nimbus...	4.4	Hidden					Light rain.
Summit	9.00 p. m.	23.810	64	33	33	33	90	N.W.	26	3.36		Nimbus...	4.4	Hidden					Heavy snow.
Base	9.17	27.17	52	44	44	44	100	Calm				Nimbus...	4.4	Hidden					Light rain.
Summit	11.57 p. m.	23.790	62	31	31	30	90	N.W.	56	15.66		Nimbus...	2.4	Hidden	5.10 p. m.			.38	Sleet.
Base	11.14	27.14	54	34	34	34	100	Calm				Nimbus...	4.4	Hidden	4.30 p. m.			.03	Light rain.

Station, summit and base of Mount Washington, New Hampshire. Elevation of summit above sea-level, 6,292.5 feet. Height of barometer at summit above ground, 3 feet. Elevation of base above sea-level, 2,531 feet. Height of barometer at base above ground, 34 feet.

Paper G, (sub-paper.)

Meteorological record for the five days ending May 5, 1872.

Day and date of obser- vation.	Time of observa- tion.	Barometer.	THERMO- METER.		HYGRO- METER.		Relative humi- dity.	WIND.			CLOUDS.		RAIN OR SNOW.		Remarks.
			Attached.	Exposed.	Dry bulb.	Wet bulb.		Direction.	Velocity per hour.	Pressure per sq. ft.	Daily ve- locity.	Amount. (moving from—)	Commenced.	Ended.	
Wednesday, May 1, 1872	7.00 a. m.	30.28	66	47	47	43	70	S.W.	12	72	72	1.4			
	8.00 a. m.	30.28	66	48	48	44	70	S.W.	12	72	1.4	1.4			
	9.00 p. m.	30.22	69	52	52	46	60	S.	14	98	98	4.4			
	12.02 p. m.	30.20	70	46	45	42	76	S.	14	98	924	4.4			
	12.02 a. m.	30.18	68	44	43	36	43	S.	11	60	34	3.4			
Thursday, May 2, 1872	7.00 a. m.	30.02	64	45	44	41	83	S.	6	18	34	N.	7.10 a. m.		Threatening. Light rain.
	8.00 a. m.	30.01	64	46	45	44	92	S.	8	32	34	N.			.05
	9.00 p. m.	29.89	67	49	49	49	100	S.	13	84	260	4.4			.12
	12.02 a. m.	29.86	68	48	48	48	100	Cal.	3	04	4.4	4.4			Fog. Dense fog.
	7.00 a. m.	29.89	60	47	47	47	100	E.	3	04	4.4	4.4	11 a. m.		Fog. Fog.
Friday, May 3, 1872	8.00 a. m.	29.85	59	45	45	45	93	N.W.	6	18	2.4	2.4			.24
	9.00 p. m.	29.85	71	50	49	46	93	N.E.	3	04	150	1.4	After 9 a. m.	6 a. m.	Threatening.
	12.02 a. m.	29.84	71	42	42	41	91	N.	3	04	0	0			
	7.00 a. m.	29.95	70	40	39	39	100	N.E.	4	08	4.4	4.4			Fog and light rain.
	8.00 a. m.	29.96	69	40	39	39	100	N.E.	6	18	4.4	4.4	6.20 a. m.		Light rain.
Saturday, May 4, 1872	9.00 p. m.	29.95	67	43	43	43	92	N.E.	12	72	4.4	4.4			.05
	12.02 a. m.	29.95	64	43	43	43	92	N.E.	6	18	2.4	2.4			.03
	7.00 a. m.	29.96	63	41	41	41	100	N.W.	1	01	108	4.4	9 p. m.		Light rain.
	12.02 a. m.	29.97	58	40	39	38	91	N.	7	24	9.4	4.4			Heavy rain.
	8.00 a. m.	29.97	58	42	41	41	91	N.	8	32	9.4	4.4			.12
Sunday, May 5, 1872	9.00 p. m.	29.92	73	52	51	45	52	N.W.	12	72	2.4	2.4			.08
	12.02 a. m.	29.92	72	50	50	44	52	N.W.	14	98	194	3.4			.08
	7.00 a. m.	29.87	68	48	48	44	70	W.	10	50	4.4	4.4			.12
	12.02 a. m.	29.87	68	48	48	44	70	W.	10	50	4.4	4.4			.08
	7.00 a. m.	29.87	68	48	48	44	70	W.	10	50	4.4	4.4			.08

Station, Portland, Maine. Elevation of ground above sea-level, 35 feet. Elevation of barometer above ground, 19 feet.

Meteorological record for the five days ending May 10, 1872.

Day and date of observation.	Time of observation.	Barometer.	THERMOMETER.		HYGROMETER.		Relative humidity.	WIND.			CLOUDS.		RAIN OR SNOW.		Remarks.
			Attached.	Exposed.	Dry bulb.	Wet bulb.		Direction.	Velocity per hour.	Pressure per sq. ft.	Amount.	Direction from—	Commenced.	Ended.	
Monday, May 6, 1872.	7.00 a. m.	29.91	70	45	45	42	76	N.	8	32	4.4	S.			
	8.02 a. m.	29.83	64	45	45	41	68	N.	8	32	3.1	S.			
	9.00 p. m.	29.98	60	49	48	44	70	S.E.	10	30	3.4	W.			
	5.02 p. m.	30.00	60	47	47	44	71	S.E.	10	30	3.4	S.	9 a. m.	10 a. m.	.02
	12.02 a. m.	30.01	70	44	44	42	84	S.	7	24	2.4				
Tuesday, May 7, 1872.	7.00 a. m.	29.95	71	45	45	41	92	N.W.	2	04	4.4				
	8.02 a. m.	29.83	65	59	59	52	61	N.W.	2	04	4.4	S.E.			
	9.00 p. m.	29.94	67	61	61	52	61	N.W.	12	72	1.4	S.			
	5.02 p. m.	29.98	63	49	49	45	71	S.E.	3	12	3.4	S.			
	12.02 a. m.	30.00	61	46	46	44	81	S.	8	32	2.4				
Wednesday, May 8, 1872.	7.00 a. m.	30.00	62	45	45	42	76	S.W.	4	08	0				Faint aurora.
	8.02 a. m.	30.01	71	46	46	41	44	Calm			2.4	N.			
	9.00 p. m.	30.00	70	48	48	46	85	S.W.	3	04	1.4	S.			
	5.02 p. m.	30.01	72	65	65	58	59	E.	6	18	0				
	12.02 a. m.	30.05	71	65	61	53	57	Calm	7	24	1.4	S.E.			
Thursday, May 9, 1872.	7.00 a. m.	30.11	67	56	56	53	87	Calm			103				
	8.02 a. m.	30.07	65	53	53	52	80	N.	3	04	2.4				
	9.00 p. m.	30.04	59	49	47	45	85	E.	3	04	4.4				
	5.02 p. m.	29.98	62	48	46	46	85	S.E.	4	08	4.4	E.			Threatening.
	12.02 a. m.	29.79	61	46	47	45	85	F.	6	18	2.4				
Friday, May 10, 1872.	7.00 a. m.	29.71	63	49	47	45	92	Calm			89	0			
	8.02 a. m.	29.70	63	61	61	57	62	S.	9	40	0				
	9.00 p. m.	29.80	65	64	64	61	32	W.	11	60	0				
	5.02 p. m.	29.83	68	74	74	69	39	W.	16	1.38	1.4				
	12.02 a. m.	30.06	70	70	70	56	39	N.	15	1.12	1.4				
	5.02 p. m.	30.14	68	62	62	51	41	N.E.	13	.84	1.4				
	9.00 p. m.	30.28	64	51	51	45	50	N.E.	6	.18	191	0			
	12.02 a. m.	30.35	63	50	50	45	65	N.	3	.04	2.4				

Station, Portland, Maine. Elevation of ground above sea-level, 35 feet. Elevation of barometer above ground, 19 feet.

Meteorological record for the five days ending May 15, 1872.

Day and date of observa- tion.	Time of observa- tion.	Barometer.	THERMOM- ETER.		HYGROME- TER.		Relative humid- ity.	WIND.				CLOUDS.	RAIN OR SNOW.		Amount of rain or melted snow.	Remarks.
			Attached.	Exposed.	Dry bulb.	Wet bulb.		Direction.	Velocity per hour.	Pressure per sq. ft.	Daily ve- locity.		Amount.	Direction (moving from—)			Commenced.	Ended.
Saturday, May 11, 1872.	7.00 a.m.	30.38	62	51	51	45	S. E.	2	.02	...	1.4	Light rain. Light rain. Dense fog. Dense fog. Hazy.
	8.02 a.m.	30.39	63	49	48	44	S. E.	2	.32	...	3.4	...	...	...	...
	2.00 p.m.	30.34	62	48	46	43	S. E.	7	.24	...	1.4	E.	...	...	...
	5.02 p.m.	30.29	60	46	46	43	S. E.	8	.32	...	3.4	E.	...	...	...
Sunday, May 12, 1872.	9.00 p.m.	30.31	58	42	42	41	S. E.	4	.04	167	4.4	...	8.30 p.m.	Cumulus and stratus.
	12.02 a.m.	30.11	60	42	42	41	S. E.	4	.08	...	4.4	...	...	...	...
	7.00 a.m.	30.99	58	45	44	44	S. E.	1	.01	...	4.4	...	...	...	...
	8.02 a.m.	30.96	58	46	45	45	S. E.	2	.02	...	4.4	...	...	...	...
Monday, May 13, 1872.	2.00 p.m.	30.89	74	64	64	58	S. W.	10	.32	...	0	N. E.	Cirro-cumulus clouds.
	5.02 p.m.	30.85	69	55	55	52	S. W.	9	.50	...	1.4	N. E.	...	...	...
	9.00 p.m.	30.85	71	51	51	50	S. W.	10	.40	108	2.4	...	...	...	...
	12.02 a.m.	30.84	73	53	53	47	N. E.	6	.18	...	2.4	...	...	...	...
Tuesday, May 14, 1872.	7.00 a.m.	30.90	71	55	55	55	N. E.	14	.98	...	1.4	E.
	8.02 a.m.	30.90	71	55	55	55	N. E.	14	.98	...	1.4	E.	...	...	...
	2.00 p.m.	30.91	69	57	57	51	S. E.	10	.50	...	0	...	...	...	...
	5.02 p.m.	30.91	67	56	56	52	S. E.	4	.08	...	2.4	N. E.	...	...	...
Wednesday, May 15, 1872.	9.00 p.m.	30.96	68	52	52	49	S. W.	4	.08	208	4.4
	12.02 a.m.	30.00	64	56	56	46	S. W.	4	.08	...	4.4	...	...	...	...
	7.00 a.m.	30.13	63	52	52	42	N. W.	10	.50	...	2.4	...	...	...	...
	8.02 a.m.	30.14	63	54	54	43	N. W.	8	.32	...	1.4	...	...	...	...
Thursday, May 16, 1872.	2.00 p.m.	30.16	64	62	61	50	S. E.	5	.12	...	1.4
	5.02 p.m.	30.18	62	55	54	47	S. E.	7	.24	Blk.	1.4	S. E.	...	...	...
	9.00 p.m.	30.21	62	51	51	44	S. W.	5	.12	...	2.4	...	...	...	...
	12.02 a.m.	30.21	62	51	51	44	S. W.	5	.12	...	1.4	...	...	...	...
Friday, May 17, 1872.	7.00 a.m.	30.27	66	53	53	43	N. W.	9	.40	...	1.4
	8.02 a.m.	30.27	66	54	54	43	N. E.	5	.12	...	1.4	...	...	...	...
	2.00 p.m.	30.17	63	60	60	47	S. E.	8	.32	...	2.4	S. E.	...	...	...
	5.02 p.m.	30.17	62	53	53	45	N. W.	8	.32	...	2.4	S. E.	...	...	...
Saturday, May 18, 1872.	9.00 p.m.	30.17	62	51	51	46	N. W.	4	.08	Blk.	0
	12.02 a.m.	30.14	67	46	46	42	W.	4	.08	...	0	...	...	...	...

Station, Portland, Maine. Elevation of ground above sea-level, 35 feet. Elevation of barometer above ground, 19 feet.

Meteorological record for the five days ending May 20, 1872.

Day and date of observation.	Time of observation.	Barometer.	THERMOMETER.		HYGROMETER.		Relative humidity.	WIND.				CLOUDS.		RAIN OR SNOW.		Amount of rain or melted snow.	Remarks.
			Attached.	Exposed.	Dry bulb.	Wet bulb.		Direction.	Velocity per hour.	Pressure per sq. ft.	Daily velocity.	Amount.	Direction (moving from—)	Commenced.	Ended.		
Thursday, May 16, 1872	7:00 a. m.	30.11	73	48	48	39	36	N. W.	8	.28	0	0	0	Dense haze.
	8:00 a. m.	30.09	73	51	49	40	36	N. W.	10	.28	0	0	0	.....	.....	.....
	9:00 a. m.	30.08	69	55	50	41	31	N. N.	10	.27	0	4.4	0	.....	.....	.....
	9:00 p. m.	30.02	69	51	50	41	39	N. N.	30	2.00	0	0	0	.....	.....	.....
	12:00 p. m.	30.02	65	50	49	41	44	N. W.	6	.18	156	3.4	S. W.	.....	.....	.....
Friday, May 17, 1872	7:00 a. m.	30.03	68	47	47	40	48	Calm.	0	.40	0	2.4	S. W.	Dense haze.
	8:00 a. m.	30.01	66	50	50	43	51	N. N.	16	1.28	0	1.4	S. W.	.....	.....	.....
	9:00 a. m.	30.02	69	52	50	44	47	N. N.	12	.72	0	1.4	S. W.	.....	.....	.....
	9:00 p. m.	30.97	66	60	53	48	43	S. E.	6	.18	0	3.4	S. W.	.....	.....	.....
	12:00 p. m.	30.99	63	55	53	48	56	S. E.	6	.18	221	4.4	S. E.	.....	.....	.....
Saturday, May 18, 1872	7:00 a. m.	30.04	62	49	48	45	70	S. W.	8	.29	0	0	0	Hazy.
	8:00 a. m.	30.02	65	48	48	44	44	S. W.	4	.08	0	0	0	.....	.....	.....
	9:00 a. m.	30.02	67	50	50	46	54	N. E.	5	.19	0	0	0	.....	.....	.....
	9:00 p. m.	30.53	63	53	53	46	47	S. E.	11	.60	0	0	0	.....	.....	.....
	12:00 p. m.	30.84	62	55	55	47	50	S. E.	15	1.12	0	0	0	.....	.....	.....
Sunday, May 19, 1872	7:00 a. m.	30.83	61	49	48	45	72	S. W.	7	.18	137	0	0	Hazy.
	8:00 a. m.	30.84	62	49	48	45	73	S. W.	6	.18	0	0	0	.....	.....	.....
	9:00 a. m.	30.85	73	57	57	49	52	S. W.	6	.18	0	0	0	.....	.....	.....
	12:00 p. m.	30.83	72	57	57	49	52	S. W.	4	.08	0	0	0	.....	.....	.....
	4:00 p. m.	30.74	70	52	51	49	86	S. E.	6	.18	0	4.4	E.	.....	.....	.....
Monday, May 20, 1872	7:00 a. m.	30.74	61	49	48	46	100	N. E.	6	.18	0	4.4	E.	Threatening. Light rain.
	8:00 a. m.	30.66	70	50	50	50	100	N. E.	11	.60	202	4.4	E.	.....	.....	.....
	9:00 p. m.	30.55	72	49	49	49	100	N. E.	10	.50	0	4.4	E.	.....	.....	.....
	12:00 a. m.	30.50	73	55	55	54	93	W.	8	.32	0	4.4	E.	.....	.....	.....
	2:00 p. m.	30.50	72	57	57	55	87	W.	8	.32	0	4.4	E.	.....	.....	.....
Monday, May 20, 1872	4:00 a. m.	30.50	75	70	70	57	40	W.	12	.72	0	4.4	E.	Clearing.
	8:00 a. m.	30.51	71	69	69	56	39	W.	6	.40	192	4.4	E.	.....	.....	.....
	9:00 p. m.	30.57	68	58	58	52	34	W.	6	.40	192	4.4	E.	.....	.....	.....
	12:00 a. m.	30.58	66	55	55	51	74	W.	2	.09	0	1.4	W.	.....	.....	.....
	2:00 p. m.	30.58	66	55	55	51	74	W.	2	.09	0	1.4	W.	.....	.....	.....

Station, Portland, Maine. Elevation of ground above sea-level, 35 feet. Elevation of barometer above ground, 19 feet.

Meteorological record for the five days ending May 25, 1872.

Day and date of observation.	Time of observation.	Barometer.	THERMOMETER.		HYGROMETER.		Relative humidity.	WIND.				CLOUDS.		RAIN OR SNOW.		Remarks.
			Attached.	Exposed.	Dry bulb.	Wet bulb.		Direction.	Velocity per hour.	Pressure per sq. ft.	Daily velocity.	Amount.	Direction (moving from—)	Commenced.	Ended.	
Tuesday, May 21, 1872.	7.00 a. m.	29.46	64	56	59	52	60	W.	2	.02		4.4				
	8.02 a. m.	29.49	65	60	59	54	60	N. W.	2	.02		4.4				
	9.02 p. m.	29.72	63	61	60	55	71	Calm.				4.4	E.			
	10.00 p. m.	29.68	64	54	54	53	93	S. W.	4	.08		3.4	S.	4 p. m.	5.30 p. m.	Light rain.
	12.02 a. m.	29.98	64	53	53	52	93	Calm.			152	1.4				Clear sky.
Wednesday, May 22, 1872.	7.00 a. m.	30.00	63	51	50	50	93	Calm.				1.4	S. E.			
	8.02 a. m.	30.06	63	56	56	53	60	Calm.				1.4				
	9.02 p. m.	30.10	63	60	60	53	60	Calm.				1.4				
	10.00 p. m.	30.08	65	63	62	53	51	S. E.	9	.40		1.4				
	12.02 p. m.	30.08	64	58	58	52	64	S. E.	12	.72		2.4	E.			Light rain.
Thursday, May 23, 1872.	7.00 a. m.	30.07	63	50	50	48	86	S. E.	3	.04	76	1.4				Light rain.
	8.02 a. m.	30.05	62	49	49	46	93	Calm.				4.4				Fog.
	9.02 p. m.	29.91	55	47	47	46	92	S. E.	10	.50		4.4				
	10.00 p. m.	29.87	57	49	49	47	100	S. E.	8	.32		4.4				
	12.02 p. m.	29.73	59	49	49	49	100	N. E.	6	.18		4.4				
Friday, May 24, 1872.	7.00 a. m.	29.72	62	53	53	52	93	N.	5	.12	204	2.4				
	8.02 a. m.	29.79	61	49	49	49	93	N.	4	.08		1.4			1.30 p. m.	
	9.02 p. m.	29.85	62	58	58	55	100	Calm.				1.4				
	10.00 p. m.	29.87	65	60	60	55	71	Calm.				0				
	12.02 p. m.	29.90	66	60	60	55	71	S.	8	.32		4.4				
Saturday, May 25, 1872.	7.00 a. m.	29.88	66	62	62	56	66	S.	7	.24		1.4	E.			
	8.02 p. m.	29.90	62	51	49	48	86	S. E.	6	.18	96	1.4				
	9.02 p. m.	29.89	61	48	48	47	93	S. E.	5	.12		4.4				
	10.00 p. m.	29.85	60	52	52	51	93	S.	5	.12		4.4				
	12.02 p. m.	29.84	61	53	55	51	93	S.	7	.24		4.4				
	7.00 a. m.	29.80	62	55	55	53	87	S.	8	.32		4.4				
	8.02 p. m.	29.76	62	56	56	54	87	S.	4	.08		4.4				
	9.02 p. m.	29.76	61	58	58	57	94	Calm.				1.4	N.			
	10.00 p. m.	29.82	61	51	51	49	86	Calm.				1.4				
	12.02 a. m.	29.82	61	51	51	49	86	Calm.				1.4				

Station, Portland, Maine. Elevation of ground above sea-level, 35 feet. Elevation of barometer above ground, 19 feet.

Meteorological record for the five days ending May 30, 1872.

Day and date of observation.	Time of observa- tion.	Barometer.	THERMO- METER.		HYGROME- TER.		Relative humid- ity.	WIND.				CLOUDS.		RAIN OR SNOW.		Amount of rain or melted snow.	Remarks.	
			Attached.	Exposed.	Dry bulb.	Wet bulb.		Direction.	Velocity per hour.	Pressure per sq. ft.	Daily ve- locity.	Amount.	Direction (moving from—)	Commenced.	Ended.			
Sunday, May 26, 1872	7.00 a. m.	29.91	62	57	57	54	81	Calm.								34	E.	Hazy.
	8.03 a. m.	29.93	66	63	64	55	57	Calm.								24	N.	
	2.00 p. m.	29.98	65	65	59	51	54	S.	10	50						14		
	5.03 p. m.	29.95	63	53	53	48	67	S. W.	12	72						0		
	9.00 p. m.	29.98	63	53	48	46	85	S. W.	9	40	74					14		
Monday, May 27, 1872	12.03 a. m.	30.00	60	51	51	49	86	Calm.								24		Light rain.
	7.00 a. m.	29.95	60	51	51	49	86	Calm.								24		
	8.03 a. m.	29.96	64	57	57	52	69	S.	4	06						14		
	2.00 p. m.	29.89	65	60	60	53	60	S. E.	8	32						14		
	5.03 p. m.	29.87	64	59	59	51	54	S. E.	7	24						14		
Tuesday, May 28, 1872	9.00 p. m.	29.81	62	53	53	50	86	Calm.							11.55 p. m.	44		Light rain.
	12.03 a. m.	29.81	62	53	53	50	80	S. W.	8	32	143					44		
	7.00 a. m.	29.79	61	49	49	49	100	S. E.	3	04						44		
	8.03 a. m.	29.79	61	52	52	51	93	S. E.	4	06						44		
	2.00 p. m.	29.82	65	55	55	52	80	S.	12	72						44		
Wednesday, May 29, 1872	5.03 p. m.	29.81	64	56	56	53	81	S.	8	32						14		Light rain.
	8.03 a. m.	29.86	63	51	51	50	93	S. W.	7	24	106					44		
	12.03 a. m.	29.87	66	48	48	47	92	S. W.	6	18						14		
	7.00 a. m.	29.89	71	51	51	48	79	S. W.	7	24						0		
	8.03 a. m.	29.98	74	54	54	49	67	S. W.	7	24						0		
Thursday, May 30, 1872	2.00 p. m.	29.98	71	62	62	52	46	W.	12	72						34	E.	Threatening.
	5.03 p. m.	30.00	70	60	60	51	49	W.	10	50						24	E.	
	9.00 p. m.	30.07	68	56	56	51	69	Calm.			180					44		
	12.03 a. m.	30.07	66	52	52	49	79	W.	6	18						14		
	7.00 a. m.	30.12	65	53	53	48	67	W.	5	12						0		
	8.03 a. m.	30.13	67	57	56	49	57	W.	8	32						0		Threatening.
	2.00 p. m.	30.09	68	61	61	52	50	S.	12	72						24	N.	
	5.03 p. m.	30.07	65	56	56	50	86	S.	6	18						44		
	9.00 p. m.	30.04	64	53	52	50	86	Calm.			135					44		
	12.03 a. m.	29.98	64	51	51	50	83	N. E.	3	04						44		

Station, Portland, Maine. Elevation of ground above sea-level, 35 feet. Elevation of barometer above ground, 19 feet.

Meteorological record for May 31, 1872.

Day and date of observation.	Time of observation.	Barometer.		THERMOMETER.		HYGROMETER.		Relative humidity.	WIND.				CLOUDS.		RAIN OR SNOW.		Remarks.
		Attached.	Exposed.	Dry bulb.	Wet bulb.				Direction.	Velocity per hour.	Pressure per sq. ft.	Daily velocity.	Amount.	Direction (moving from—)	Commenced.	Ended.	
Friday, May 31, 1872.....	7.00 a. m.....	67	50	50	49	93	N. E.	6	18	...	...	...	4.4	S. W.	After 2 a. m.	...	Light rain.
	8.02 a. m.....	67	51	51	50	93	N. E.	8	32	...	...	...	3.4	S.	...	...	...
	2.00 p. m.....	70	60	60	55	71	N. W.	4	68	...	...	...	3.4	S. E.	2.30 p. m. }	10 a. m. }	...
	5.02 p. m.....	69	58	58	56	88	W.	2	63	...	...	...	4.4	E.	9.30 p. m.	4 p. m.	...
	9.00 p. m.....	64	56	56	55	93	W.	6	18	...	...	...	3.4	E.	...	...	...
	12.02 a. m.....	69	53	53	51	86	N. W.	4	68	...	...	...	1.4	...	9.30 p. m.	10.15 p. m.	...

Station, Portland, Maine. Elevation of ground above sea-level, 35 feet. Elevation of barometer above ground, 19 feet.

PAPER I.

ON THE AURORAL DISPLAYS DURING THE MONTH OF FEBRUARY, 1872

[Extracts from the monthly journals of the different stations established by the Signal Service, United States Army.]

LAKE CITY.

February 12.—A slight aurora.

February 18.—A very bright aurora in the west. This light may have been caused by fire.

February 28.—Spots of aurora throughout the western sky. Weather cloudy.

February 29.—A faint aurora throughout the whole heavens; that in the south somewhat brighter than elsewhere.

JACKSONVILLE, FLORIDA.

February 4.—Aurora polaris visible from 7.25 p. m. until nearly 9 p. m. One nearly perfect arch, streamers quite numerous and of a rose tint, at 8 p. m.

MOBILE, ALABAMA.

February 4.—On the night of the 4th a brilliant aurora was visible from 7 to 11 p. m. It became visible in the east, and spread along the sky from a point south of east to northwest, and at times rising in the sky to an altitude of about 60°. At 10.45 p. m. it rose higher, presenting at that time a most brilliant appearance. A portion extending from east to a point east of north, maintained a uniform color varying but little from a beautiful rose to a deep blood. The portions lying between north and northwest and east and southeast were throughout less brilliant, and varying very often in color, sometimes presenting a whitish appearance, and at other times deepening to a light rose color; at 9.30 p. m. it disappeared for a short time in the north and northwest, but presenting the appearance of an elliptical cloud in the east, its length being about three times its height, and of a beautiful deep blood color. The base was clearly defined, being about 10" above the horizon. Between its base and horizon a dense haze existed. It disappeared very quickly at 11.05 p. m.

CAPE MAY, NEW JERSEY.

February 4.—Clear and pleasant, with brisk and fresh winds. Barometer rising. Red aurora in the evening, in the southeast.

NASHVILLE, TENNESSEE.

February 4.—Weather cloudy. Wind southeast. An aurora made its appearance about 6½ o'clock, extending from east to west. It assumed no definite shape, but was of an extreme bright red color, and was brightest about 8.36 p. m., when it gradually disappeared, ceasing to be seen at 9.30 p. m.

BALTIMORE, MARYLAND.

February 3.—A brilliant aurora polaris was seen this evening, on the southern horizon, between 8 and 9 o'clock.

BOSTON, MASSACHUSETTS.

February 4.—6.30 p. m.—Fine display of aurora polaris south of zenith, of a deep red color.

KNOXVILLE, TENNESSEE.

February 4.—8½ p. m.—Brilliant aurora; beams shoot almost north to south, and through the zenith. The sky is deep red.

11 p. m.—Aurora disappearing very slowly.

MARQUETTE, MICHIGAN.

February 5.—9 p. m.—Brilliant auroral display. The arch throughout very well defined, being of a brilliant color, and of not much elevation above the horizon, the streamers mov-

ing along the arch from west to east, and presenting the appearance somewhat of broad waves of light.

10 p. m.—The streamers having subsided, the arch is better defined, but not of such a bright color.

11.20 p. m.—Aurora more brilliant than ever, streamers shooting up very high. The arch has not been very well defined during the display, rather resembling a great light in the north, with intervals of almost clear sky. Up to 10 p. m. there was no haze or cloud to be seen beneath the arch, but at this writing a few very long, thin, and perfectly straight-edged clouds are seen at the western end of the arch.

February 15.—11.20 p. m.—An aurora is now visible, consisting of an arch, quite well defined, resting upon a bank of thick dark haze at the eastern end of arch; streamers are observed to be shooting both upward and downward, but not to a great elevation upward, while downward they reach almost to the horizon.

11.30 p. m.—The arch has merged into a broad sheet of light, and shows signs of disappearing.

February 26.—8 p. m.—Brilliant aurora; elevation of top arch about 45° , base nearly touching horizon; colors principally white and pale crimson.

8.30 p. m.—Aurora much fainter; but few streamers visible as yet.

11.20 p. m.—Aurora no longer visible.

OSWEGO, NEW YORK.

February 9.—Northern lights commenced at 11.30 p. m., lasted until 1.30 a. m.; not brilliant.

February 19.—Northern lights same as described in article 351, page 176, Loomis. Commenced 7 p. m. and lasted until 12 p. m.; nothing unusual in their appearance.

ROCHESTER, NEW YORK.

February 28.—The assistant observer, Private Tighe, reports, at 9 p. m. last evening, the existence of two luminous arches, extending across the northern sky, being about 2° apart, and the upper one, the more luminous of the two, about 60° above northern horizon. He is unable to give duration of this phenomenon.

LYNCHBURGH, VIRGINIA.

February 4.—The aurora borealis was visible during the night of the 4th. At 7 p. m., owing to the cloudy state of the atmosphere, a reddish hue of the clouds was the only indication of the presence of the aurora. As the night advanced the weather became clear, and that quarter of the heavens from northwest to southwest, from zenith to horizon, presented a bright red appearance. The aurora grew dim in the southwest and brighter in the west and northwest at 10.30 p. m. At midnight the lights became very bright due north, resembling daylight, while in the rest of the heavens the aurora entirely disappeared.

NEW YORK CITY.

February 4.—Clear weather and brisk northwest winds. At 6.30 p. m. a brilliant aurora appeared in the north, which soon overspread the whole northern heavens. At 7 o'clock it had extended eastward and upward until it occupied a space in the southeast from about 15° to 50° above the horizon, about 70° in breadth, and assumed a blood-red tinge, so dense at times as to obscure the stars. On either side of the crimson was a perpendicular line about 10° in width and 50° in length, of a bright orange and green tint. The display lasted until about 11 p. m., when it gradually disappeared.

PHILADELPHIA.

February 4.—On the north the aurora borealis was displaying, while on the south the aurora australis reflected back with tenfold beauty the light of its cold antipodes. As at 7.20 p. m. I opened the latticed door of the shelter, a most brilliant display of glorious crimson light struck upon my gaze. Further observation discovered that a blood-tinted light, ever varying, was extending from the south to the southeast. At times the light would subside to a mellow crimson, and again, with gentle flushings, would shoot up toward the zenith. At first I thought the lurid light was the reflection of some conflagration upon the sky; yet upon opening the east door, I discovered that the northern horizon was also lighted by a pale silvery light, which at times would assume a tinge of pale green. These phenomena remained visible for the greater part of the night, for at 11.43 p. m., when my last observation was made, the rays of the aurora borealis were plainly and magnificently visible above the bank of the stratus clouds that interposed above the horizon. The aurora australis had

faded; "'twas 'neath a cloud as dark as woe," for huge and black banks of stratus had piled themselves on the horizon, so lately illuminated by the soft crimson light of the australis. The sky was becoming rapidly overcast, and at 1 a. m. was entirely obscured.

SAINT PAUL, MINNESOTA.

February 4.—A display of aurora was visible in the north and northwest. It was first seen at 6 p. m.; did not present any particular form, but was a diffused light. It had the appearance of crimson sand falling to the earth, then rolling in billows and waving toward the south, and disappearing. It became more brilliant at 8 p. m., and was then of a deep rich crimson color.

WASHINGTON, D. C.

February 4.—The auroral display first attracted the attention of the observer at 7.15 p. m. Presenting a brilliant carmine color, it gradually crept up from the northeastern limit of the horizon till it reached the zenith, when the rays began to appear divided, and presented an appearance as of a flickering flame darting down toward the southwest.

Apart from this track across the heavens there appeared curious globe-like spots of about 15° in diameter, having the same carmine color, and being arranged by the side of the path of the aurora; not less than three of these spots were noticed.

The auroral track was about 40° in width, less brilliant at the borders than in the center, and when complete could not be seen below an angle of 30°. The observation was continued until 9.15 p. m., the phenomenon presenting but slight changes.

Another, but not confined to any particular part of the heavens, was observed for a few moments at 2 a. m. February 5. The color was the same as the first, but was somewhat less brilliant.

CHICAGO, ILLINOIS.

February 4.—At 9 p. m. it cleared, and a slight aurora was perceptible. These have always or nearly always been found at this station to be precursors of colder weather and northerly winds.

February 19.—A slight dawn-like aurora was observed in the evening.

February 27.—In the evening there was a slight aurora, resembling the dawn.

KEY WEST, FLORIDA.

February 4.—At 7 p. m. a faint light, without any definite form or shape, was observed in the northeast, reaching from the east to the north and extending half-way to the zenith; gradually moving westward, passing by the north, until about 2.30 a. m., when its center had reached the western point of the horizon, and could no longer be observed, in consequence of the sky becoming overcast with clouds. A dense haze was observed at its base during the entire time, and at 9 p. m. large black clouds moved from the west and passed by its base. When it first appeared its color was very faint, and after intervals of five minutes it increased in brightness, its color becoming a rose hue, and again, after an interval of five minutes, it would entirely disappear, and again re-appear, very faint at first, but would gradually increase in brightness, and so on during the entire time it could be observed. It was brightest at about 1 a. m., when it was of a red color, the amount of moisture in the air at the time being 88 per cent.

CHARLESTON, SOUTH CAROLINA.

February 4.—An aurora visible in the northeast at 7 p. m., extending from zenith to the horizon, of a light red color at first, but died away into a pale yellow at 9 p. m., when the haze became very dense.

GALVESTON, TEXAS.

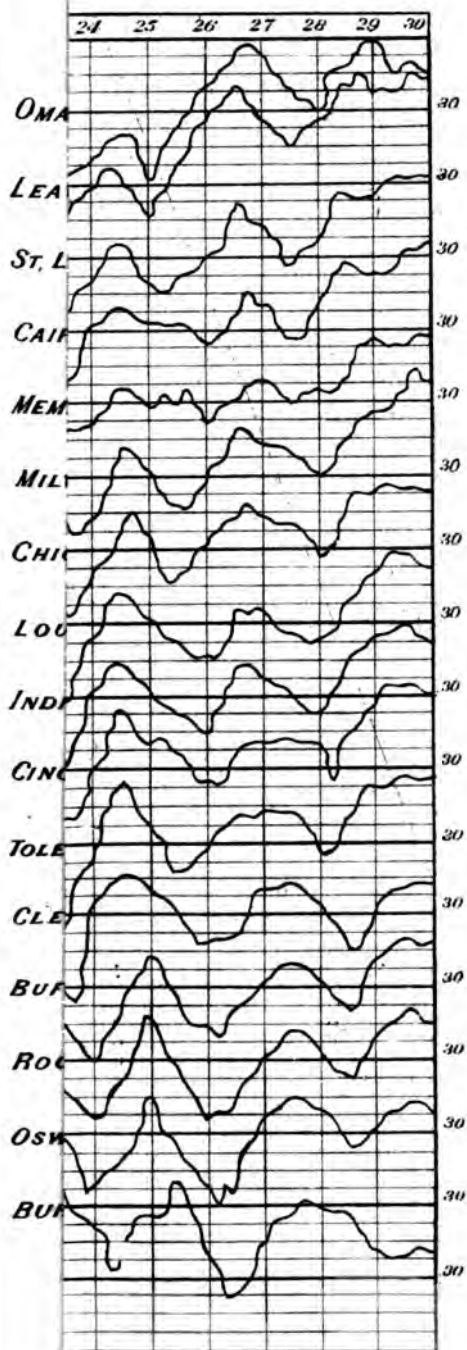
February 4.—Cloudy, barometer falling. Brilliant aurora, color bright red; began 6.45 p. m.; too cloudy to see it plainly till about 10.50 p. m., when the sky cleared. It gave a steady light, shining up about 35° above the horizon. Began to disappear 11.30 p. m.; totally disappeared 11.40. Barometer falling, temperature 57° and relative humidity 100. Wind southeast, 16 miles per hour. Heavy dew falling.

DU LUTH, MINNESOTA.

February 4.—At 6.30 p. m. very red light running east and west. South of Du Luth it was brightest at the east. At 9 p. m. beams began to shoot up at the north; it was not very brilliant.

MILWAUKEE, WISCONSIN.

February 4.—Snow; aurora in the southeast.



PAPER J.

DESCRIPTION OF THE STORM OF NOVEMBER 11-16, 1871, IN ITS PROGRESS FROM OMAHA EASTWARD.

At Omaha the barometer commenced falling on the morning of the 11th from 30.19; temperature raised 18°; barometer continued falling until the morning of the 13th to 29.83, when it rose rapidly; .70 of an inch of rain had fallen; wind unsteady, from fifteen to twenty-five miles per hour, northwest.

At Leavenworth, barometer 30.40, began to fall at 7 a. m. on the 11th; continued falling until the afternoon, when it held pretty steady until 7 a. m. of the 12th, again falling rapidly until midnight to 29.95; thermometer raised 25°; 1.10 rain-fall; wind thirty-five to thirty-eight miles, first from southeast, changing to northwest by the south. At this time one central area of high barometer was about Cairo, and another about Chicago and Milwaukee.

At St. Louis the barometer, 30.38 at noon of the 12th, began falling; continued until 6 p. m. of the 13th to 29.70; thermometer raised 15°; a high wind followed at midnight of the 14th from northwest, and 1.94 inches rain fell. The high area is now in Pennsylvania, and the low area west of Omaha.

At Cairo the barometer began falling at 3 a. m. of the 11th; continued falling rapidly until near midnight of the 13th-14th, at which time the wind raised to thirty-five miles per hour, first from the southeast, and changing to northwest. It began to rain at 6.30 a. m. of the 13th; amount, 1.83 inches.

At Davenport the barometer, 30.38 at 7 a. m. of the 12th, fell rapidly until its minimum, at noon of the 13th, was 29.83; the temperature rose 15°; wind brisk from east, changing to southeast, thence northwest. Rain began at 7.20 p. m. of the 12th, continued until 9.40 a. m. of the 13th; amount, .61 of an inch.

At Chicago the barometer, 30.47, began falling at 7 a. m. of the 12th; continued until midnight of the 13th-14th to 29.66; at 10.53 p. m. of the 13th the wind raised to 33 miles, from northwest, having veered from the south. Rain began at 6.30 a. m. of the 13th, ceased at 12.30 a. m. of the 14th; amount, 1.18 inches.

"Up signals" ordered at 6.40 p. m. of the 13th; "Down" at 1.13 a. m. of the 15th; thirteen hours' notice was given of the storm. Observer reports, "Signal justified; several vessels staid in harbor and escaped the gale."

At Milwaukee the barometer, 30.49, began falling at 7 a. m., and continued until 6 p. m. of the 13th to 29.68, followed by brisk wind from northwest. Rain commenced falling at 7.30 a. m. of 13th; ended at 2 a. m. of 14th; amount, .60 inch. "Up signal" was ordered at 7 p. m. of 13th, thirteen hours previous to the storm. Observer reports: "No damage to vessels, as all remained in harbor."

At Memphis the barometer, 30.31 at 6 a. m. of the 12th, commenced falling; reached 29.62 at 4 p. m. of the 13th; temperature rose 20°; wind twenty miles an hour from the northwest; rain began at 6 p. m. of the 12th; amount, .50 inch.

At Louisville, on the morning of the 12th, the barometer, 30.40, commenced falling, and fell rapidly until 8 a. m. of the 14th to 29.44, the thermometer rising 14°. At 7 a. m. of the 14th the wind rose to twenty-two miles, and at 4 p. m. to twenty-five from the northwest. Rain began at 8 a. m. of the 13th; ended at 3 p. m. of the 14th; amount, 1.15 inches.

At Indianapolis the barometer commenced falling at 7 a. m. from 30.45; fell to 29.45 at 6 a. m. of the 14th; thermometer rose 17°; wind brisk from southeast; changed to northwest; rain began at 8.30 a. m. of the 13th; ended at 4.20 p. m. of the 14th; amount, 1.93 inches.

At Grand Haven the barometer fell from 30.56, 6 a. m., on the 12th, to 29.58, 7 a. m. on the 14th; temperature rose 20°; the wind at 5 p. m. of the 14th rose to thirty-one miles from the north; rain commenced at 9 a. m. of the 13th, ended at 8 a. m. of the 14th; amount, 1.06 inches.

"Up signals" was ordered at 12.37 p. m. of the 14th, giving five hours' notice of the gale.

At Cincinnati the barometer commenced falling about 7 a. m. of the 12th from 30.55; fell rapidly to 29.45 at about 7 a. m. of the 14th; temperature rose 25°; rain commenced at 12.30 p. m. of the 13th; ended at 8 p. m. of the 14th; amount, 2.21 inches; the wind at 11 p. m. of the 14th rose to thirty miles an hour from northwest.

At Toledo the barometer began to fall during early morning of the 12th; fell until 4 p. m. of the 14th; at 11 p. m. of the 14th the wind had risen to a gale from the northwest; rain fell to the amount of 3.19 inches. "Up signals" was ordered at 11 a. m. of the 14th, giving twelve hours' notice.

At Detroit the barometer at 30.58 began to fall on the morning of the 12th; fell rapidly until the morning of the 14th to 29.48. The storm reached its height at midnight of the 14th-15th, blowing a gale from the northwest; rain-fall 1.95 inches. "Up signals" ordered twelve hours previous to gale.

At Cleveland the barometer 30.58, at 7 a. m. of the 12th, fell rapidly to 29.35 at 4 p. m. of the 14th; at 11 p. m. of the 14th the wind rose to 36 miles an hour, unsteady between northwest and southwest; thermometer raised 25°, and fell rapidly following the storm; barometer rising rapidly; rain-fall 1.54 inches. "Up signals" ordered at 11.10 a. m., twelve

hours before the gale. Observer reports: "Screw H. C. Williams, Captain Fuller, saw signal being hoisted, but left port. She was obliged to put back about 7 p. m., and in endeavoring to enter the harbor struck the pier and went down; one of the crew drowned. Some other vessels which put out returned in a damaged condition, and several lives lost. Many steamers, schooners, &c., staid in port on account of warning signal."

At Buffalo the barometer 30.62, at 7.28 a. m. of the 12th, fell to 29.23 at 11.28 p. m. of the 14th; at 3.30 a. m. of the 15th the storm began, and at 7.30 a. m. was at its highest. The observer states: "An unknown amount of property and perhaps a great many lives have been saved. The warning was given some fifteen hours before the violence of the storm was felt at this station. It was heeded by marine men, and no vessels left port during its display. The storm was the most violent known on the lakes for years." Rain fell to the amount of 2.70 inches.

At Rochester the barometer 30.63, at 7.32 a. m. of the 12th, fell to 29.25 at 7.32 a. m. of the 15th; temperature raised 24°. The wind at 2 p. m. of the 14th raised to 30 miles an hour, first from southeast, then changed to northwest. Rain fell to the depth of 2.09 inches.

At Oswego, at 7.37 a. m. of the 12th, the barometer at 30.61 fell rapidly to 29.29 on the 15th at 7 a. m.; thermometer raised 13°. The gale commenced at 6.45 a. m. of the 16th. "Up signal" was ordered at 1.15 on the 14th, twenty-two hours before the gale reached its height. Many vessels were detained by the signal. Some put out and returned in a damaged condition. One vessel went ashore and was a total wreck.

This storm did not reach Montreal, although the barometer fell nearly an inch; the wind did not exceed fourteen miles, but a heavy fall of rain, amounting to 3.54 inches, is recorded.

At Burlington, Vermont, the barometer fell 1.03; the wind raised to eighteen miles, and but .18 inch rain fell. At the same time (between the 13th and 16th) another storm, or part of this one, was moving up the Atlantic coast.

PAPER K.

THE STORM OF MARCH 1 AND 2, 1872, ALONG THE ATLANTIC COAST.— (With seven maps.)

The morning telegraphic weather reports of March 1, 1872, from the signal stations along the Gulf coast, indicated an area of low barometer to be rapidly developing in that region. The barometer at New Orleans was then 29.87, and the direction of the wind at all of the Gulf stations was northeast, while at Punta Rassa and Key West westerly winds prevailed. The probabilities issued on that morning predicted falling barometer for the eastern gulf, with continued cloud and rain and increasing easterly winds. Toward the afternoon the wind at Punta Rassa and Key West changed to south and southwest respectively, and the storm-center was rapidly approaching the northwestern coast of Florida. The barometer fell quite rapidly at the Gulf and south Atlantic stations, and rain set in at New Orleans, Mobile, Lake City, Jacksonville, Savannah, and Charleston, and by 4.35 p. m. (Washington mean time) about one-half inch had fallen at most of these stations. The wind was still northeast there, and reached a velocity of twenty-two miles at New Orleans, but the lowest barometer was reported from Lake City, 29.71—falling .21 in eight hours.

The probabilities in reference to this storm, issued at 7 p. m., read as follows: "The low barometer south of Western Florida move northeastwardly into the South Atlantic States during the night; the area of rain extending by Saturday morning to Virginia," and dangerous winds were predicted for the South Atlantic coast.

The storm, now fully developed, moved during the evening into Georgia, with fearful violence, cutting off telegraphic communication with Florida, and at 11.35 p. m. (Washington mean time) the barometer at Savannah had fallen to 29.37, a depression of .52 in eight hours, with a northeasterly gale blowing sixty miles an hour. It was raining then at Wilmington, Augusta, Charleston, and Savannah, and snowing at Lynchburg and Knoxville.

The storm was then predicted to move, or to continue moving, northeastward along the South Atlantic coast; the area of rain to extend during the night over the middle Atlantic coast, and cautionary signals were promptly ordered and displayed by 2 a. m. of March 2, at Savannah, Charleston, Wilmington, and Norfolk, and the further progress of this severe storm will show how fully these predictions were verified.

The reports of the morning of March 2 showed the storm-center to be central over the southern coast of North Carolina, the barometer at Wilmington being extremely low, 29.27, having fallen .53 during the latter part of the night; at Charleston 29.47, at Norfolk 29.47, (wind fifty-five miles per hour,) while the pressure gradually recovered at the more southern stations. The heaviest rain-fall was then reported from Savannah, being nearly one inch in a few hours. The steamer Rising Star, en route from New York to Aspinwall, encountered this storm when entering the Gulf stream on the morning of March 2; the barometer fell

.76 in eight hours; and when in longitude $74^{\circ} 12'$ and latitude $34^{\circ} 3'$, at 12 m., the barometer stood at 29.00. A "tremendous sea" raged all that day, and the vessel made hardly any progress. The storm moderated toward midnight, and the steamer escaped without any serious damage.

The morning probabilities in regard to this storm read: "The very low barometer over the southern North Carolina coast move northeastwardly over Cape Hatteras, preceded by very brisk and high northeasterly winds from thence to Cape Cod; the area of snow extending northeastward over the southern New England States during the day."

The display of cautionary signals at Wilmington and Norfolk was continued, while orders to hoist them were at once sent to Baltimore, Cape May, New York, and New London.

As predicted, the storm kept moving northeastwardly along the coast with terrific violence, and by 4.35 p. m. its center was evidently at some distance off the New Jersey coast, and the area of snow had extended into Massachusetts, with rapidly falling barometer; the barometer fell at Philadelphia to 29.67; at New York, to 29.67; at Cape May, to 29.48—the wind at the latter place being northwest, and blowing thirty-two miles per hour, and one continuous snow-storm prevailed along the coast from Portland, Maine, to Norfolk, Virginia.

The afternoon probabilities predicted the storm to still continue moving northeastwardly during the night, and the midnight reports of this day showed its center off the coast of Maine, with undiminished force, the barometer at Portland being 29.57, and at Boston 29.55, while the pressure began to recover south of New York. On the morning of March 3, the pressure was still very low over and along the coast of Maine; but the storm-center had already passed within the limits of the stations, and shipping disasters reported from Halifax showed that the storm must have been very severe over New Brunswick and Nova Scotia.

The accuracy with which the early development and the subsequent progress and path of this storm has been traced and predicted by this Office, prevented many disasters, both on land and sea, and the reports from the stations where cautionary signals had been displayed state that numerous vessels were kept in port, thereby saving many lives and an immense amount of property. Savannah, Georgia, papers estimate the amount of property saved at that and other southern ports at "probably several millions."

PAPER L.

THE STORM OF SEPTEMBER 28 AND 29, 1872. (With seven maps.)

A rapid fall of the barometer at Fort Sully, Dakota, on the 27th of September, indicated the existence of an area of low pressure in the far Northwest; and, although no further telegraphic reports were received from that station at midnight of the same day, it was evident that a storm was moving down the Upper Missouri Valley, by the diminishing pressure reported from Omaha and Leavenworth. The wind was blowing from a southerly direction from Omaha eastward to Lake Michigan, and southward as far as Saint Louis.

The reports, received the following morning, showed that the storm had advanced very rapidly during the night southeastward, as predicted; and its center was then somewhere between Leavenworth and Keokuk. The wind at Omaha had already changed to northwest; while at Leavenworth it was north, at Saint Louis east, at Keokuk southeast, and at Davenport east; thus completely encircling the storm center, and clearly defining its rotary motion. It was also raining hard at Saint Louis, Keokuk, and Cairo. The "probabilities" issued at 10 a. m. on the morning of the 28th predicted diminishing pressure and rain for the upper lakes and Lake Erie; thus giving a timely warning of the approach of the storm along the lakes, where the barometer was then still above the normal height. The storm path had been due southwest so far; but the afternoon reports of the 28th showed that the predictions from this Office, viz, falling barometer on the upper lakes, &c., were fully justified, as the pressure diminished very rapidly at Chicago, Grand Haven, and Toledo; and it was then evident that the storm, now fully developed, would sweep across the lakes, and cautionary signal orders were at once telegraphed to Milwaukee, Chicago, Grand Haven, Toledo, Cleveland, Buffalo, and Detroit; but were not received at Milwaukee and Grand Haven, through the neglect of the telegraphic company charged with their transmission and delivery.

The storm was then central over the southwestern portion of Illinois, with heavy rain and very brisk northwesterly winds at Keokuk, Davenport, and Chicago; while at Saint Louis, Cairo, Louisville, and Indianapolis, the wind had already changed to a southerly direction. The lowest barometer was now reported from Saint Louis, being 29.44; and from Lake Erie westward, toward the storm center, the atmospheric pressure diminished .10 of an inch for every sixty miles. The storm moved northeastwardly during the day, with terrific northeasterly gales on Lake Michigan, and westerly gales on Lake Erie; and from

the midnight reports of the 28th, was found to be central over Northern Indiana. The lowest barometer was then reported from Chicago, being 29.35; and heavy rain prevailed at Chicago, Milwaukee, Grand Haven, and Detroit.

The midnight "probabilities" predicted the storm to continue moving northeastward over the lower lake region, with easterly gales for Lake Michigan, backing to northwesterly toward the morning; and for Lakes Erie and Huron, shifting to northwesterly during the evening; and for Lake Ontario, shifting to northwesterly toward the night. And the cautionary signals, hoisted at the lake-stations in the forenoon, were continued.

These prognostications were verified with fatal punctuality; and the severity of the storm over the lakes, during the following night, was almost unprecedented; and, as its approach had been announced from 8 to 12 hours in advance, the amount of property saved must have been immense. Still, quite a number of shipwrecks occurred, the storm overtaking vessels that had not been within reach of the warnings.

The reports of the morning of the 29th showed that the storm was then central over Northern Michigan, and that the pressure had diminished eastward to the Atlantic coast, while brisk westerly winds prevailed over Lake Michigan, and southwesterly over Lake Erie.

The storm was then predicted to continue moving northeastward into Canada, and down the Saint Lawrence Valley, with northwesterly gales over Lake Huron during the day, and over Lake Ontario during the night; and the warning-signals, already ordered on Lake Ontario, were continued; and the Canadian stations were properly notified of the approaching storm.

Lake Huron came in for its full share of the storm during the day, with heavy rain at Alpena, Saugeen, and Toronto; and the storm-center reached Canada in the afternoon, and the Saint Lawrence Valley on the morning of the 30th, thus having traveled a distance of nearly 2,400 miles in about eighty-four hours, at an average velocity of thirty miles an hour. The path of this storm described an almost perfect rectangle, with its vertex at Saint Louis; and its severity, especially after reaching the lake-region, exceeded anything experienced on those waters for years.

PAPER M.

ROCHESTER, NEW YORK, *September 5, 1872.*

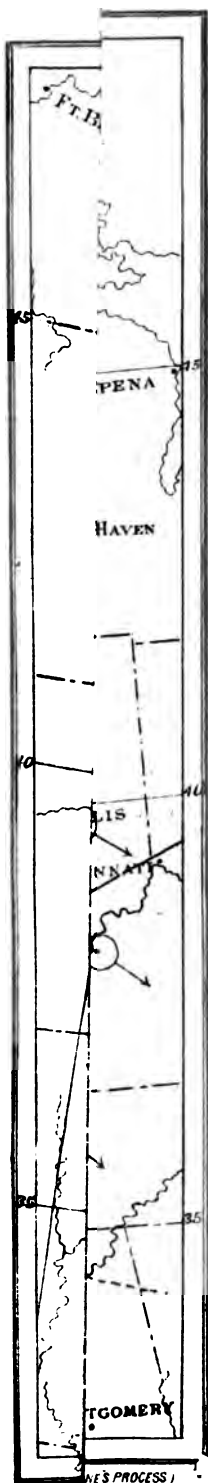
GENERAL: In accordance with Special Order No. 103, dated Office of the Chief Signal-Officer of the Army, August 16, 1872, and written instructions previously received from you, I proceeded to Rochester, New York, to make such observations as you had directed, in the balloon "Aurora," which was expected to ascend from Falls Field, Rochester, on Thursday, the 29th day of August, at 3 p. m.

Having made careful comparisons of the different instruments, with the several standards, previous to leaving Washington, the comparisons were renewed upon arriving in Rochester with the instruments at the observer's office in Power's Block.

All necessary arrangements were made, and I repaired to the ground selected for the ascension some time previous to the hour named, with the instruments in readiness to ascend.

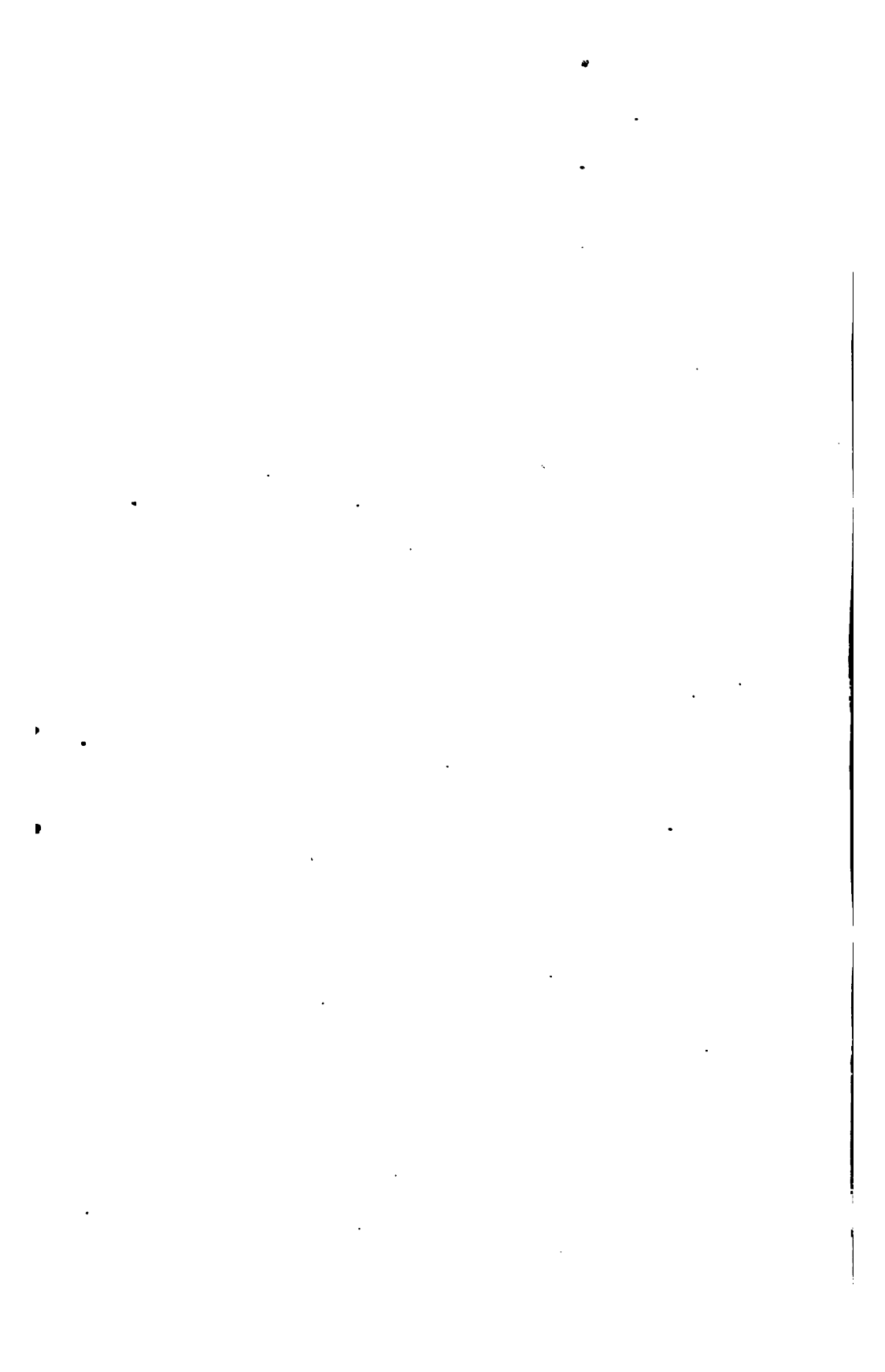
Professor Samuel A. King, the aeronaut, had selected his balloon "Aurora" for this ascension. This balloon and the car belonging to it were made in France, and have been used by Professor King in various ascensions during the past two or three years, the capacity being about 20,000 cubic feet. The balloon was two-thirds inflated on my arrival on the ground. Professor King informed me that owing to the heavy wind then prevailing, the fact of its blowing directly toward Lake Ontario, and the threatening state of the weather, he had decided to postpone the ascension until Monday, September 2, at 3 o'clock p. m. I at once advised you of this fact by telegraph. The wisdom of Professor King's decision was manifest shortly after dark the same evening, when a steady rain set in and continued during the night, accompanied by a high southerly wind. The great difficulty the aeronaut had to contend with was the long time required for inflating the balloon, being about fifteen hours. This fact, in conjunction with the presence of a high wind, led Professor King to further postpone the ascension until Tuesday, the 3d of September, at 3 p. m., of which fact you were duly informed by telegraph. It was necessary to commence inflating the balloon at 12 o'clock, midnight. I was on the ground at that time, Sunday night, with the professor, and the fact of its being very dark, with the wind still blowing fresh from the northwest, seemed to justify his decision. Careful comparisons with the several instruments were continued meanwhile, and arrangements made with the observer at Rochester for making synchronous observations while the balloon was up in the air.

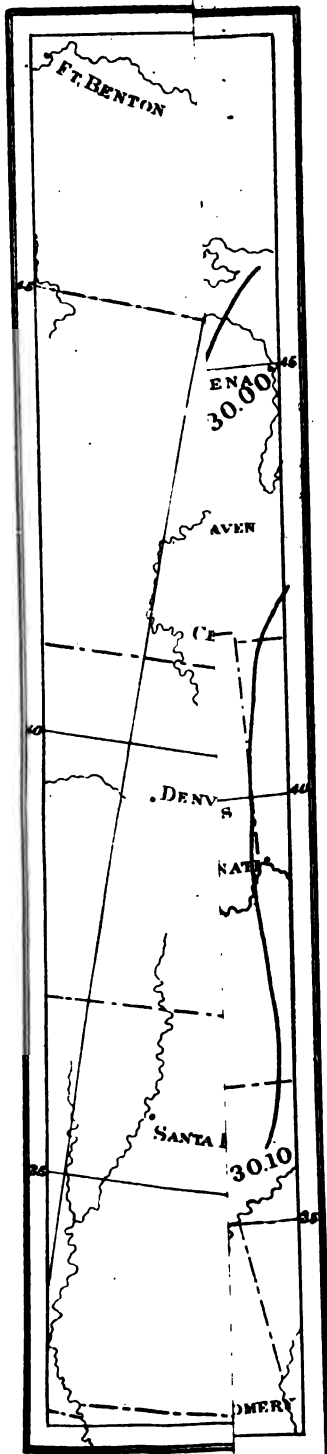
I proceeded to Falls Field Tuesday, the 3d of September, and having fixed the instruments in position in the car of the balloon, made continuous observations from 2h. 53m. 15s. p. m., until 4h. 30m. 10s. p. m., when the car was attached to the balloon preparatory to starting. The inflation proceeded slowly until shortly before 5 p. m., when the hose was cast off, and the aeronaut and myself got into the car.



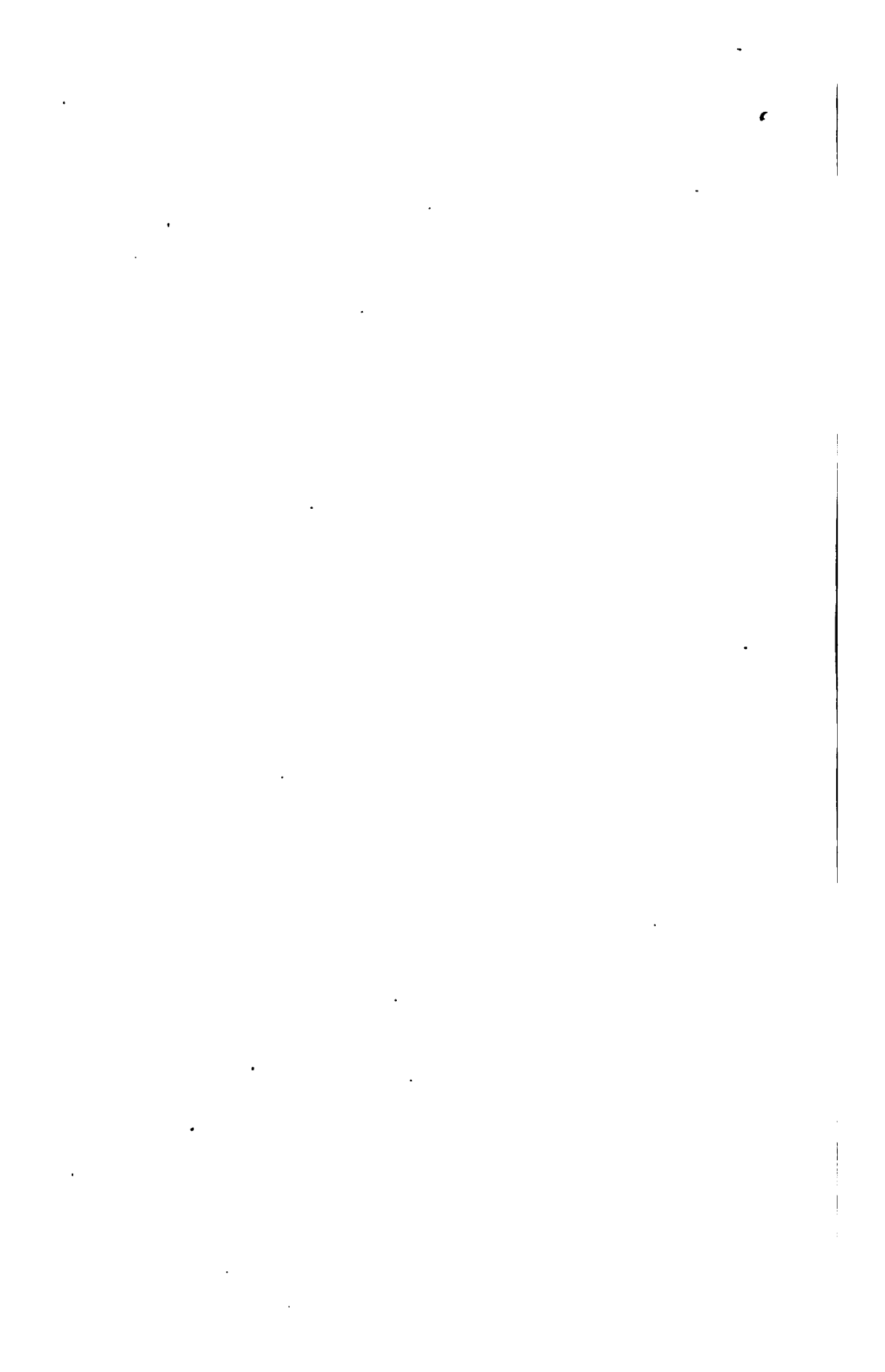
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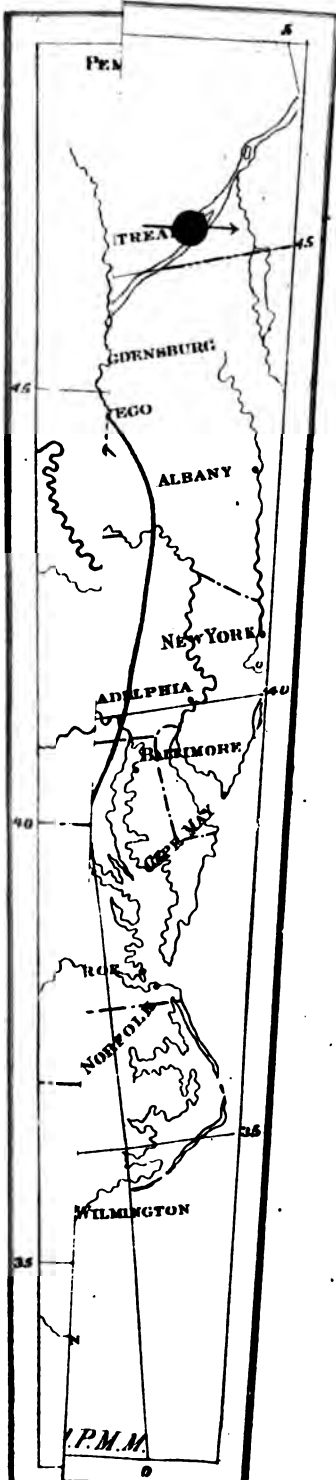


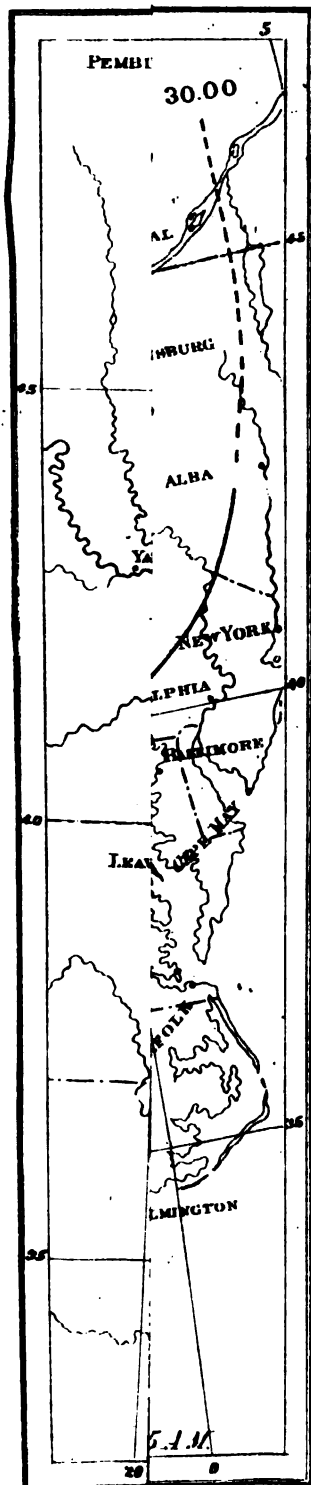


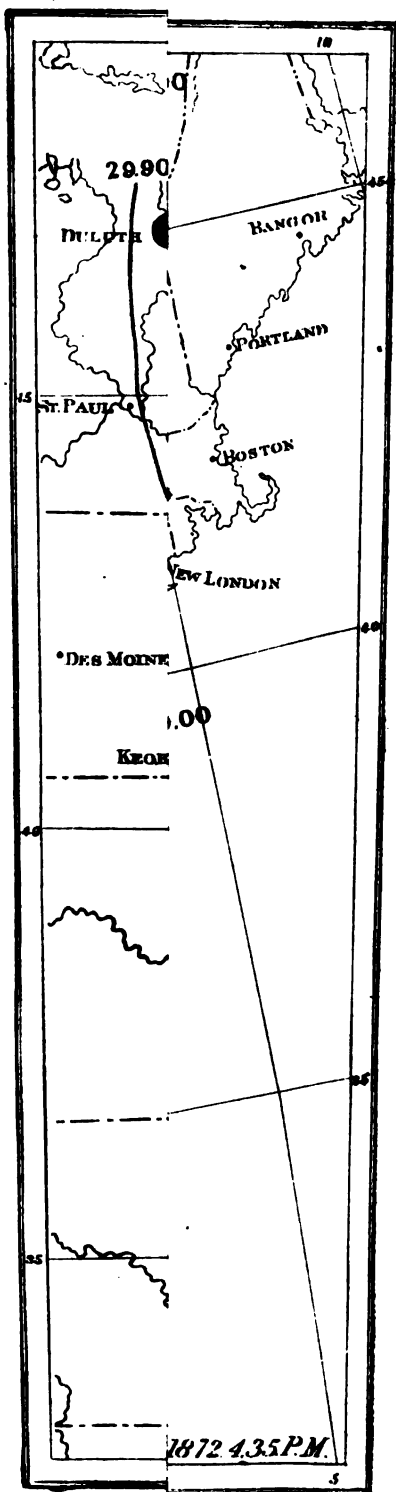


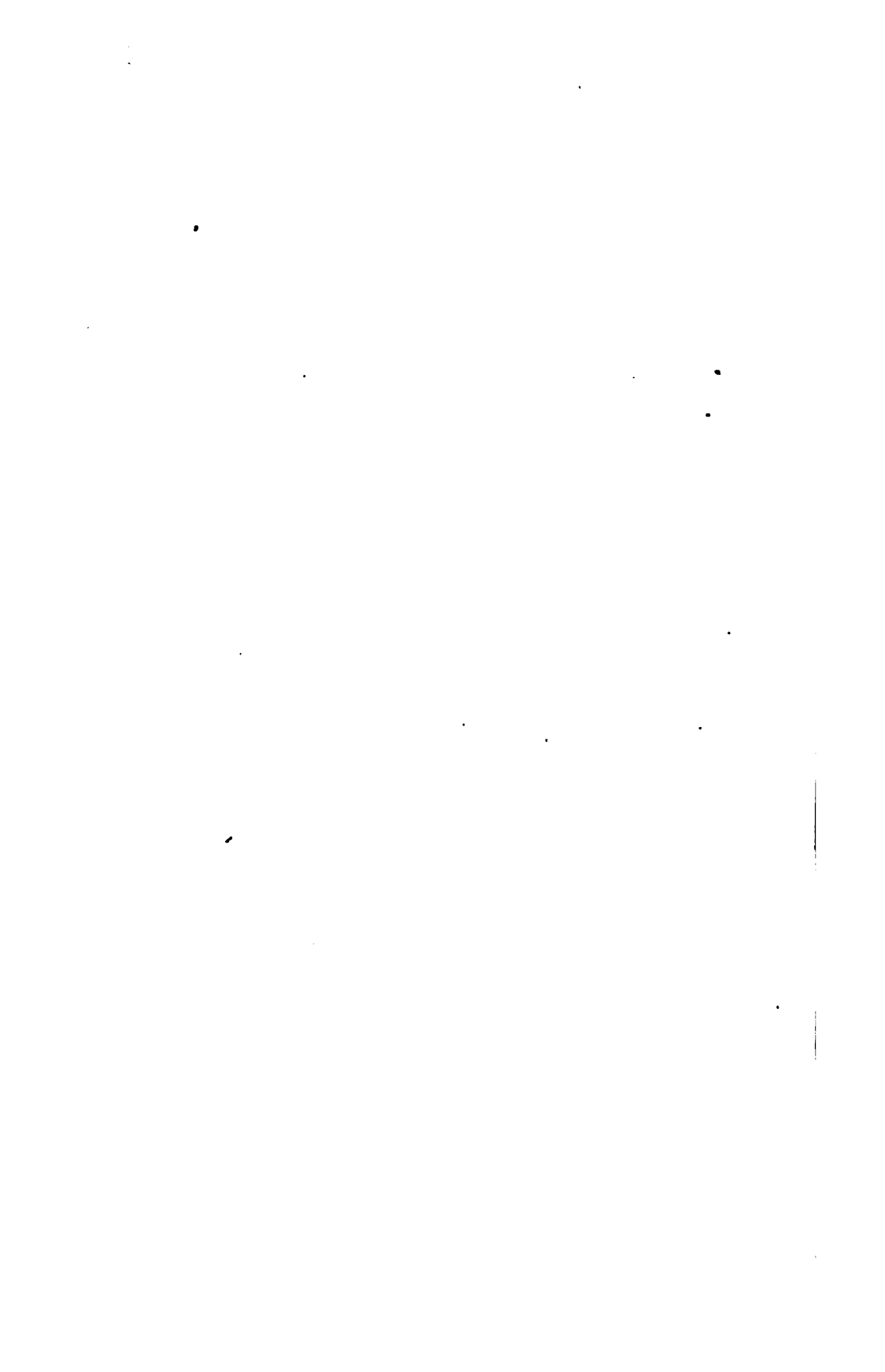
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After testing the lifting power of the balloon, and getting the car properly ballasted, the last rope was cast off, and we started on our aerial voyage at 5.03½ p. m., Washington time.

I made eighty-two complete sets of readings in the car, resting on the ground, previous to its being attached to the balloon.

After everything was in readiness to start and the ropes all cleared away, I had the instruments handed to me in the car, and began my readings at the instant we started.

I took readings from Green's aneroid barometer, and the dry and wet bulb thermometers of Glaisher's hygrometer, from 5½. 3m. 15s. p. m., the time of starting, at the same time keeping the direction of the balloon in the record, until 6.21 p. m., the time we landed. Tiffany's aneroid barometer was also read from the time of starting until 5.10 p. m., when it ceased to register, owing to the fact of its reading down to 26 inches only.

At 5½. 49m. 30s. p. m., the clock attached to this instrument stopped, and I lost four minutes and a half in getting out my watch.

Tiffany's barometer was read for a few minutes afterward, but the readings were so much out that they were discontinued.

I made, on an average, two observations a minute—sometimes getting three and at others only one a minute.

As the object of this voyage was to ascertain how many observations could be taken in a given space of time, and to see if it was practicable to use the balloon for making meteorological observations with any degree of accuracy and safety, I devoted my attention entirely to this duty, and did not take any time to observe the view of the country over which the balloon was passing, excepting an occasional glance when attention was especially called to anything by the aeronaut.

I made one hundred and fifty-six observations while in the balloon. The following day I made forty-seven observations, at the house of Mr. Timothy Buell, a few rods from where we descended.

Upon my return to Rochester, I renewed the comparison of my instruments with those at the observer's office in that city. Upon returning to the Office of the Chief Signal-Officer I shall again make careful comparisons with the standards. A detailed description of the voyage in narrative form is embodied in my report, as of general interest, and, also, adding to the value of the data obtained.

We left the earth amid the shouts of the thousands of spectators and ascended quite rapidly, moving a little south of east. The temperature decreased considerably as we arose above the earth, falling 20° in ten minutes. The sky was perfectly cloudless, and a light northwest wind prevailed. The aeronaut estimated our speed at about thirty miles an hour. We observed a thick haze in the northward, and also quite a haze in the westward. The view of Lake Ontario was very fine. The country we passed over was highly cultivated, and presented the appearance of one vast garden spread out beneath us. The noise of the crowd below was soon hushed, and for awhile the only sound perceptible was the rumbling of the railroad trains. This soon ceased, and perfect stillness reigned supreme for a short time, broken only by the voice of the aeronaut remarking upon the magnificent view spread out before us. We apparently passed along for some distance parallel with the New York Central Railroad, for upon the balloon descending a little the roar of the trains was plainly heard. The aeronaut called my attention to a small lake which, from its position, I judged to be Lake Canandaigua. At our greatest elevation the air was quite chilly, the breath being perceptible as in winter, although I did not feel at all inconvenienced by the change, being provided with warm clothing.

Our course changed at 5½. 12m. 10s. p. m. to due east, and at 5½. 13m. p. m. to southeast, which we kept until 5½. 24m. p. m. when we moved a little south of southeast until 5½. 38m. 30s. p. m.; the balloon then moved south-southeast. We kept this general direction until landing.

After reaching our greatest elevation, and descending again, we moved along at a height sufficiently near the earth to enable us to converse with men at work in the fields. They were apparently much surprised at our appearance above them, and inquired facetiously where we came from, what we were doing up there, and where we intended going; which interrogatories were answered to their entire satisfaction by Professor King. All the noises incident to farm life were plainly discernible from our elevated position. Passing over a pasture we frightened half a dozen horses very much; they pranced up and down the field, and occasionally glanced upward with much alarm. We were unable to plot our course to any degree of certainty, owing to our ignorance of the country passed over.

Upon my return to Rochester, I obtained a copy of a telegraphic dispatch to the editor of the Union, dated Lima, Livingston County, at 6.20 p. m., New York Central Railroad time—about twelve minutes faster than Washington time—sent by the telegraph-operator, giving at that moment, 6½. 8m. p. m. of my time, our distance from Lima at about six miles east of there, descending slowly in a southeasterly direction. This coincides with our position, so far as I could ascertain, and can be used to advantage as a check in plotting our course. This dispatch was received by the observer at Rochester at 6.30 p. m., when he discontinued his special observations.

At 6½. 2m. p. m. we hailed a man in the field below us, and ascertained from him that

we were passing over the township of East Bloomfield. Soon afterward, the aeronaut let the guide-rope hang from the car, and drag over the ground. While traveling along in this way the balloon came down quite near the earth, so near that as we approached a fence, it seemed as if we would certainly strike against it in our descent. The professor called my attention to this, in order that I might secure the instruments. I got all ready to pick them up in my hand in case we struck. By throwing over a handful of ballast just at the right time, the balloon ascended, and passed over the fence in safety. Just before landing, we saw a large oak tree directly ahead of us. At first there was some danger of the car lodging in the tree, but by discharging a small quantity of ballast, we passed over in safety, the guide-rope barely touching one of the branches.

Professor King finally decided to descend, as it was getting toward night-fall. He requested a man in the field below us to take hold of the guide-rope. The man was then directed to take a turn around the fence with the rope. We were then gradually lowered until the car rested on the ground, touching the earth without any jar to the instruments whatever.

While the car was held down by willing hands, I took the last observation at 64. 21m. p. m. The professor treated as many of our newly made friends, as desired it, to a balloon ride.

The field proved to be on the farm, within a few rods of the house of Mr. Timothy Buell, being about two miles east of East Bloomfield railroad-station, which is a little east of the village of that name, about six miles west of Canandaigua, and some twenty-four miles from Rochester.

After taking one more observation and putting the instruments in a safe position, I drove down to the Western Union telegraph-office, at East Bloomfield, and advised you at once of my arrival on the earth again, and the success of this the first signal-office balloon-ascension for meteorological purposes.

I would mention here the courtesy of Mr. Cheney, the manager of the Western Union Telegraph Company, at Rochester, in putting under my orders one of his messengers, with blanks, &c., so that I could inform you at once of our departure from Falls Field, and also in forwarding my messages to you with all possible dispatch. Upon my return to Mr. Buell's house, I found that the aeronaut had allowed most of the gas to escape from the "Aurora," and had left our aerial carriage and its appendages in the field until daylight.

It would seem from this experiment that there is a reasonable degree of assurance that, with the same amount of care exercised in this ascension, the balloon can be used for making more elaborate meteorological observations without risk to the instruments.

Very respectfully, your obedient servant,

GEORGE C. SCHAEFFER, JR.,

Observer, Signal-Service, United States Army.

Brigadier-General ALBERT J. MYER,

Chief Signal-Officer of the Army, Washington City, D. C.

PAPER N.

STORMS ON THE PACIFIC COAST OF AMERICA.—(Compiled from various authorities.)

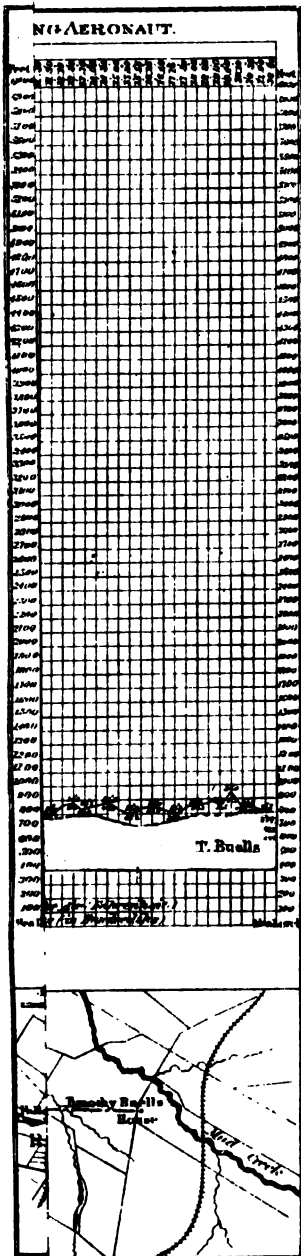
The storms of the Pacific coast more nearly resemble those of Western Europe than the storms which frequent the eastern coast of the United States. The latter move littorally, and follow a northerly and easterly course under the thermo-dynamic influence of the Gulf stream, and the mechanical agency of the great southwest equatorial current of atmosphere, which remarkably coincides with the oceanic Gulf stream.

But, on the Pacific side of our continent, the storm-controlling forces act in a direction from west to east, especially upon the coasts of California, Oregon, and Washington. The warm Kuro-Siwo, or Japan stream of the great ocean, after reaching the middle latitudes, on its way toward the Aleutian Islands, is, superficially, brought under the propelling power of the westerly or anti-trade winds; and a large drift of this Pacific gulf stream is borne eastward, as a decidedly marked warm stratum of surface-water, and strikes upon the western shores of America nearly at right angles. This agency, as well as that of the general atmospheric movement on our Pacific coast, serves to give character and direction to the storms and cyclones which reach it, no doubt from the western Pacific Ocean.

1. *From San Diego to the Straits of Juan de Fuca, from December till April, the storms of the Pacific coast set in, with southeasterly winds, veering, as the storm-center progresses, to southwesterly.

The closing winds from the north of west are very severe, and, as they blow on to the lee shore, are to be apprehended by vessels, even though in port.

**Mercantile Marine Magazine*, 1856.



THEOGRAPHIC CO. N.Y. OSBORNE'S PROCESS

Instances are not wanting in which vessels have been sunk in the Pacific ports of America by these gales from the west.

2. "These southeasterly gales are more frequent and violent north of San Diego, and thence along the coast to British Columbia; and this can be easily understood from the fact, as established by Blodget, that the humidity and rain-fall of the region stretching from San Francisco northward to Vancouver's Island are nearly three times as great as of that south of San Francisco. Unless forced by other causes to deviate from the regions of greatest humidity, we know, storms seek or are drawn into such regions for their necessary supply of aqueous vapor. On the Pacific coast there are no other known agencies which would cause such deviation.

3. †It follows, therefore, that the ports of San Francisco and Portland, Oregon, and the waters of the adjacent sounds, are more endangered by storms than San Diego, or than points along the coast between San Diego and San Francisco.

In summer the latter port is so far south of the usual storm-track that it is comparatively safe; but it is otherwise from December to April.

4. The northeasterly wind, which on the Atlantic sea-board is often a violent premonitor of a storm, on the California coast, and northward does not precede, but follows the cyclone in its closing northwest quadrant, and is usually of moderate force.

5. After striking the Pacific coast, the storm will generally advance with but little diminution of cyclonic intensity, but with diminished progressive motion, in a direction east-northeast. The violence of the storm will not cease till the center has passed beyond the Coast Range Mountains.

6. The great upper current or stratum of warm and moist equatorial atmosphere, which, in England, has been observed to move in a southwest direction, is, on our Pacific coast, less meridional in its course, and pushes more toward the east, especially north of the parallel of 48° north latitude, where it is favored in this more easterly direction by the orographic features of the continent, which are less elevated and bold than they are south of this parallel.

7. ‡Vessels sailing southward from San Diego to Mexican ports are peculiarly exposed from June to November from severe gales, beginning generally at southeast or southwest. These southeast gales may be looked for in still greater severity and frequency, especially during winter and the equinoctial seasons, all the way from San Diego to the Straits of Juan de Fuca, and attended with thick, rainy weather.

8. Vessels sailing northward to San Diego from Mexican or southerly ports, should they encounter a gale moving up the coast, should stand off on the starboard tack, thus getting the eastward wind of the cyclone, which removes the danger of going ashore.

RECURVATION OF STORM-PATHS IN THE EASTERN PACIFIC.

§Most of the cyclones which I have last described, however, must have recurvated in a more advanced position in the Pacific Ocean; and in their subsequent northeasterly progress they would fall almost perpendicularly upon the coasts of the two Californias, or the more northern Territories. Thus, instead of sweeping a great length of these coasts successively, as happens on our Atlantic border, these cyclones appear more like local storms, and cannot be traced consecutively on the coast line. At the point of intersection with the coast, the first and main portion of the gale will be felt from the southeast, on its center path, or more southerly in its right-hand quadrants. And near the coast, the northeasterly or reflex winds of the cyclone, pertaining to its first left-hand quadrant, will not be strongly developed.

We learn from Lieutenant-Commander Wood, of Her Majesty's ship Pandora, that from Cape San Lucas to San Diego, or from latitude 23° to latitude 32° north, the coast is subject to violent gales from southeast, from November to April, and that they are more frequent as we go toward San Diego. Before their recurvation, these cyclones are likely to have passed westward in lower latitudes than those which fall on the Mexican coast.

From San Diego to San Francisco the coast is subject to southeasterly gales like those of the coast of Lower California, but they are more frequent here, and blow with greater force. These gales, according to Lieutenant Wood, "last from twelve hours to two days, and are accompanied by heavy rain, which lasts till the wind changes, which it often does very suddenly, and blows as hard for a few hours from the northwest, when the clouds clear off, and fine weather again succeeds." This is a clear description of the phenomena of cyclones, as shown on their center paths, while moving in a northeasterly course. The same authority states that from San Francisco to the straits of Juan de Fuca hard gales from all points of the compass may be looked for at all seasons. These begin generally from southeast to southwest, bringing thick, rainy weather with them. After blowing from these quarters for some hours, they fly round to the northward, by the west, with little if any warning, and blow even harder than before. These changes show the observer to have been in the right-hand quadrants of the gale, as most often will happen, and are but counterparts of the changes met with in the cyclones encountered in the same latitudes in the North Atlantic.

*English Nautical Magazine, 1850.

†Deductions from foregoing.

‡Innery's Sailing Directions for the west coast of North America.

§Mr. William C. Redfield on cyclones on the Western Pacific.

UNIVERSALITY OF THE LAW OF STORMS.

The law of rotation and progression in storms, as developed on the Atlantic Ocean, which was substantially discovered by the present writer in September of the year 1821, is essentially cosmical or world-wide in its origin and application. This soon became apparent in examining the accounts of gales which are found in the voyages of Cook, Vancouver, and others, in the several oceans and climatory zones of our globe. Hence, the polar relations of the phenomena presented are necessarily changed in the southern hemisphere, where, in all our relative comparisons, south must be substituted for north, east and west remaining the same.

PAPER O.

SOME DEDUCTIONS FROM THE TRI-DAILY BAROMETRIC AND THERMOMETRIC MEANS FOR JUNE, 1871.

I. The monthly means of tri-daily barometric and thermometric observations present several interesting and instructive meteorological facts. For the month of June, 1871, it is ascertained that the highest barometric mean is at Pittsburgh, Pennsylvania, and is 30.06, 30.00, 30.06. The lowest barometric mean is at Buffalo, New York—29.90, 29.83, 29.82. The highest thermometric mean is at New Orleans, Louisiana—81, 85, 78. The lowest thermometric mean is at San Francisco—52, 63, 55. The greatest diurnal variations of the barometer is found to take place at Saint Louis, and is .14 of an inch. The least diurnal variation of the barometer is found equally at Grand Haven and Key West, and is 00.02. The variation is nearly as small at Chicago, Escanaba, and San Francisco, being at each of these places only 00.03; at New York, only 00.04. The variations most nearly approximating that of Saint Louis are at Portland, Maine, Cincinnati, Saint Paul, and Washington, at each of which places it is 00.10. The average diurnal barometric variation at all the stations is 00.059.

It appears that the insular and littoral-stations on the sea-coast and Gulf, *e. g.*, Key West, San Francisco, Cape May, Charleston, and New York, have the most uniform pressure and temperature. This uniformity is in a marked degree shared by all the lake stations. Key West has the least diurnal thermometric variation, it being only 1° F.; while Leavenworth has the greatest, 13° F. The average diurnal thermometric variation of all the stations is 9° F. The diurnal barometric variation is directly traceable to the diurnal variation of the thermometer, under the influence of solar heat and nocturnal radiation from the earth's surface.

Thus the fact that the greatest barometric variation (00.14 inch) takes place at Saint Louis is explained by the fact that the greatest thermometric change (13° F.) occurs a little west of it, at Leavenworth, in Kansas. The least diurnal variation of the barometer at Grand Haven and Key West (00.02) is explained by the least diurnal thermometric changes at these places, which are respectively 6° F. and 1° F. (†) The places whose barometric changes most nearly approach these are coast and lacustrine stations, *e. g.*, Chicago, Escanaba, New York, and Cape May, whose thermometric changes are very small. It also appears that stations on or near the same meridian of longitude experience a simultaneous and harmonious variation, *e. g.*, Washington and Charleston.

Stations.	Barometer.	Thermometer.
Washington	30.00, 29.91, 29.99	69°, 79°, 69°
Charleston	30.01, 29.96, 30.01	78°, 84°, 79°

The connection between the barometric and thermometric results has been long since a matter of theory. As the atmosphere becomes warmed by the sun's heat it is expanded and swollen above its nocturnal height, and its upper or intermescent portion will flow off laterally in all directions to places of lower barometer, and the pressure will diminish. When the sun has disappeared the expanded volume contracts, and there is formed a partial depression into which the air from all sides flows in and the pressure is increased. It does not appear that the total lunar aerial tide affects the barometer very sensibly, *i. e.*, to a greater extent than .005 of an inch, a total effect which seems to be only .01 of the diurnal variation, attributed to solar heat. By a simple calculation from the observed average diurnal barometric and thermometric variations, respectively .059 or .06 of an inch and 9° F., we deduce the general law, that for every increase of temperature 1.5 F. the pressure in the

mercurial column diminishes .01 of an inch. This, it will be observed, applies in the United States, where most of the stations are not strictly continental, nor insular, but littoral. It appears that the greater the absolute humidity of any station, the greater will be the diurnal oscillation in the barometer, as compared with that in the thermometer, since the sun's rays will cause a greater expansion of aqueous vapor than of dry air. Thus, at Charleston, on the humid sea-coast, we have—barometer, 30.01, 29.96, 30.01; variation, .05 of an inch. Thermometer, 78, 84, 78; variations, 6° F; and at Washington, almost littoral, we have—barometer, 30.00, 29.90, 29.99; variation, .10 of an inch. Thermometer, 69, 79, 69; variation, 10° F. At such stations 1° F. rise in the thermometer nearly represents .01 of an inch barometric fall; but at Memphis, a continental station, it takes a thermometric rise of 12° F. to cause a barometric fall of .05 of an inch, and at Leavenworth, another continental station, it requires a rise of 13° F. in the thermometer, to produce a fall of .04 in the barometer. To arrive at some mean expression for the law of inverse barometric and thermometric variations, we should take the mean difference between the readings for the littoral and continental stations. To give this average in figures corrected for all stations, including such interior stations as the signal-service may hereafter occupy, the approximate expression would be an *inverse variation equal to .01 of an inch in the barometer for every thermometric change of 30° F.*

II. We may also apply these conclusions to the consideration of *annual variation* of temperature and pressure in their relation to questions of climatology and terrestrial physics. It clearly follows from what has been shown, that there is a regular annual variation of the barometer, according with the movement of the sun in declination.

The oceanic surface in the southern hemisphere being much greater than in the northern hemisphere, the evaporation of the southern hemisphere in its summer greatly exceeds that in the northern hemisphere. Hence, the total atmospheric weight is greater at that time. Regarding the constituent of dry air in the earth's atmosphere as a *constant* quantity, we have, from September to March, the additional and excessive evaporation from the southern oceans, which causes the annual variation in the barometric condition of the entire globe to reach its maximum in the winter of the northern hemisphere. The expansion of air in the southern hemisphere in summer must cause a large amount of the superincumbent atmosphere to flow off laterally into the northern hemisphere, and, in a smaller degree, *vice versa*. Contraction of air in the winter of either hemisphere must be followed by a barometric rise, as is seen in the diurnal contraction about 4 a. m.

It follows, also, that the advance of the seasonal isothermal lines, with the motion of the sun in declination, will be accompanied by retrogression of the isobars of highest pressure. The amount of inverse annual barometric variation will be approximately 00.01 of an inch for every thermal variation of 1.5° F.

III. It would also seem that this formula is not inapplicable to the investigation of the law of storms. For, if it be true, it follows that the depression in the center of storms is not due mainly to latent heat evolved by condensation, as Mr. W. Clement Ley says in his work, the latest authority in meteorology would have us believe, but rather to *centrifugal* force of the cyclone. The rise of the thermometer 30° F., which is an extreme increase of temperature in the storm center, would only give a fall in the barometer of .15 of an inch, whereas a fall of 2.00 inches has often been observed.

It should be stated that while these deductions are drawn from the means of June 1871, these means very nearly correspond with those prepared for March, April, and May, of the same year.

PAPER P.

ATMOSPHERIC CONDITIONS AND THEIR EFFECTS UPON VEGETATION JUNE 1, 1871, TO MAY 31, 1872.—LEAVENWORTH, KANSAS.—PREPARED BY OBSERVER-SERGEANT GEORGE H. BOEHMER, SIGNAL-SERVICE, UNITED STATES ARMY.

June, 1871.—Although the minimum temperature did not reach that of the corresponding month of last year, it exceeds that of June, 1870, by 8° 5. The mean, too, of this year, was 5° in excess of the average of thirty-four years. These high thermal conditions, with good and timely supplies of rain, have obtained important results in the vegetable kingdom. Corn is beginning to tassel; is of strong, vigorous growth, promising an early and extraordinary crop. So exuberant is the growth, that on well-cultivated farms the original cost of production will not exceed 12½ cents per bushel.

The fruit trees and vines are bending under their load of fruit. Already the market is well supplied with ripe apples, at lower rates than usual. The grapes, thus far, have shown no tendency to disease, and in a few weeks more the ripe fruit will make its appearance in market. From the extraordinary yield in prospect, it may be expected that prices will range low, and this favorite and healthful fruit will come within the reach of all.

River attained maximum height on June 18; after that, falling slowly. From June 9 to 11, the rise was so rapid that it presented a threatening appearance to residents on low bottom lands.

July, 1871.—The temperature was a fraction above the mean of thirty-four years, though we had some oppressive weather, not so much from the high thermal range as the excessive moisture contained in the air.

The rains were abundant, though not copious, except in the first week of the month. Of the heaviest rain of the season, July 5, 1872, Major Hawn writes, (*Leavenworth Times*, July 7, 1872:—) "On Wednesday, July 5, at night, we were visited by one of those peculiarly gentle showers that droughty Kansas is occasionally the recipient of. About sunset a dark and portentous cloud obscured the declining sun. Soon after sunset the rising cloud was permeated with a net-work of chain-lightning that rendered the ponderous mass luminous, in the highest degree brilliant, and often blinding. Soon the distant muttering of thunder added interest to the scene, increasing in tone until it resolved itself into a regular cannonade with a thousand batteries. Anon there was a gentle rustling among the foliage of the trees, then a sweep that made the rickety buildings creak in their foundations, and then Old Boreas came down upon us in rage and fury, while the clouds poured down in breakers of water. The rain lasted during most of the night, interspersed with gusts of wind and constant electrical flashes and deafening thunder, and there fell nearly two inches of water. The wind did some damage in prostrating corn and in dislodging fruit, and occasionally damaging or destroying a tree; but the loss in the vicinity is not material. The storm was anticipated for twenty-four hours. The *signal-service reports* indicated a low range of barometer at this place and Omaha, with a high temperature and a large percentage of humidity."

The season was very favorable for the growth of vegetation and equaled that of spring.

The early planting of corn is nearly all mature now, and will be fit to cut in a week or ten days. It is the heaviest crop ever raised in Kansas or in any of the Western States.

During the month the market was well supplied with apples. Peaches were brought forward on the 18th, and melons on the 20th of July. Grapes were first offered about the 26th of July. Sweet potatoes and nearly every variety of roots and vegetables are unusually fine, and yield largely.

River fell to 9 feet water in channel on the 15th of July, and is still declining, though slowly.

August, 1872.—The temperature of the summer was 4 degrees above the mean, though it did not reach the maximum by 9°. The temperature was uniform without any extreme fluctuations. There was an unusual preponderance of clear sky, though our rains came in gentle showers, well-timed, and in no instance produced a flood.

We were free, too, from those destructive storms which so frequently occurred in different portions of the country.

The summer was but a prolongation of the spring.

September, 1871.—The most prominent feature of the month was the great preponderance of clear sky. There were many consecutive days without a cloud. The temperature of the month was within a fraction of the mean of thirty-four years.

The rains were slight, but the ground was well saturated during the summer. So that, thus far, the lack of moisture has not affected the young plants of the fall sowing.

The clear, dry weather has rendered the vintage rich, with the certainty of high flavored strong wines.

The weather has been very favorable for out-door work, and all the branches of productive industry confined to the open air are in lively progress.

There were two light, white frosts on the 27th and 28th, but no ice has yet been observed.

The last frost in spring occurred on the night of the 11th of April, which was the only frost in that month, leaving an interval of 169 days free from frost.

October, 1871.—This month was peculiarly Italian in temperature. The large preponderance of clear sky, the mild temperature (mean 60°) rendered the season a delightful one.

We had but a few white frosts, but ice did not form until the night of the 31st. The last ice of spring froze in the last week in March, giving us over seven months interval free from a temperature of freezing water.

We had sufficient rain to sustain the vegetation, as the luxuriance of the fields of young grain will attest.

On the 4th of this month we experienced one of the so-called Kansas siroccos, (Major Hawn's description of the same in *Leavenworth Times*, October 7, 1871.)

November, 1871.—Up to the 19th November, the temperature and other atmospheric conditions, particularly the frequent warm showers of rain, resembled spring more than autumn. Up to that date we had had but three frosts that produced ice since the 23th of March.

The favorable weather brought forward the plants of the prospective grain crops very rapidly, and were deeply rooted at the close of the growing season, and in good condition for the winter season.

The latter portion of the month was unusually severe and cold. The river closed at Atchison on the 28th, and at Kansas City.

December, 1871.—The mean temperature fell 5.51 degrees below the mean of thirty-four years. In fact, winter set in vigorously on the 19th of November, and with the exception of a few days continued sharp to the close of the year.

On two occasions the mercury ranged at 5° below zero, and in some localities 8°; and a few reports are to the effect that the peach-buds were slightly damaged. If this be the case, it must be limited to but few localities. There was but little freezing and thawing during the month, and the wheat plant was covered with snow much of the time, but has sustained no injury thus far.

A friend who has observed the winters here for a long time noticed an article in the Saint Joseph (Missouri) paper, saying that there was a recurrence of the severe winter every seven years, and, turning to his diary of 1864, found as follows:

"Severe winter.—Hundreds of Government teams hauling over the ice all winter. Heavy snow-storm November 3; wind blowing; river freezing. On the 22d the ice was running in large quantities. On the 7th December river closed once more; teams crossed till January 17. Began crossing again January 22, continuing till February 10. On 11th of February ice broke up and passed down the current."

This was in 1864, and we have a repetition of the same experience this winter.

Of the storm of the 25th December, 1871, a writer gives the following article in the Leavenworth Times of December 27, viz:

"The late spell of weather is pronounced, by the oldest inhabitants of Kansas, to be the most severe one that visited Kansas since the first settlement of the State. We have frequently had colder weather for a few hours at the time, but for genuine solid winter-wind, snow-drift, sleighing, &c., (all that,) the storm of the past few days was the most severe that ever visited us.

"This occasion afforded the United States signal service an excellent opportunity to show its efficiency, and illustrate its value to the people. The approach of the storm was foretold several days before it came, and those who pay attention to the weather-reports were forewarned and prepared."

January, 1872.—The mean temperature of the month was 2.97 below the mean of thirty-four years.

The winter set in about the 20th of November, and continued, up to the close of the month, with but little intermission. The temperature was uniform, the air dry, without rain, and less than two inches of snow.

The ground was uncovered during the most of the time, and the wheat-fields have a sorry appearance, though the germ of the plant is probably good, as there was but little freezing and thawing.

Some of the peach-buds sustained a slight injury, in the early part of the winter; and as the temperature has not been lower than this, at any time, it is hoped that they are safe. When the wood thaws out it will be ascertained whether they can survive a range of cold from 3° to 6° below zero for four or five consecutive mornings.

February, 1872.—The mean temperature of the winter-months fell but 18° below the mean for thirty-four years, yet it proved to be one of the severest in this region, probably, since 1831. This was not in degree, but from its great duration. Nor did the mercury fall to the minimum, at any one time, by many degrees; but a low mean extended through nearly four months. Nor can we yet write in poetical strains of balmy breezes, for the ground is partially covered with snow, and the frost is still predominant.

During the most of the winter the surface of the ground lay uncovered to the blast, that told legibly on vegetation. The wheat-fields have suffered to a considerable extent, but, as there was but little of alternate freezing and thawing, the probability is that the injury is not equal to appearances now; and, upon the return of warm sunshine and genial showers, the prospects will materially brighten. The reports from different localities are that the peach-buds are damaged, particularly the grafted fruit.

We would look with incredulity upon this being applicable in general results, as the lowest temperature marked only 10° 5 below zero; whereas, in former years, abundant crops were produced after the mercury had descended 14° below zero. It will require a brisk flow of the sap to develop the damage. The amount of snow and ice in the mountains should reasonably make us look for rough and changeable weather until late in the season.

River broke up on the 20th of February.

March, 1872.—The remarks of February (that a cold spring might be expected) were verified in March, the mean temperature being over 5° below the annual mean. The cold weather began in November, and on the 21st of March it was snowing heavily, and as cold as it ordinarily is in the middle of winter; and there does not seem any show yet for a let-up in the weather; and although, for the last two weeks, it has been alternate sunshine and storm, storm seems now to have the ascendancy. The prospective wheat-crop has undoubtedly suffered by the winter and spring frosts. To what extent is not definitely known, in the different soils and in the mode of culture. The crops, too, will be late maturing, and be subject to the influences of the June rains and blasts that may follow. The prospect of a heavy crop, of fruit of every species, was never more flattering.

From the 18th of November to the 20th of March, only 2.46 inches of rain fell and 1.59 inches of snow-water.

The ground is opened from the frost, and in good tillable condition. The winter just closed was the longest on record, but not the coldest.

April, 1872.—The mean for the month was below the mean of thirty-four years, and the low temperature caused the vegetation to be twenty days later than last year. Our rains commenced early, and have been copious thus far.

Peach, cherry, and early pear trees were in full bloom on the 25th; apples followed in a few days.

The wheat has a prospect of making a fair crop, but spring-crops will go in late. Grass is taking a fine start, and will make a heavy crop.

Strawberry-plants were damaged, and the supply of fruit from home will not be equal to the demand.

Vegetation came out late in March. On the 24th of March the peach-buds first evinced a tendency toward development, and came into full bloom on the 25th of April.

May, 1872.—The prominent feature of the month was the excessive rain. The fall was 7.91 inches more than last year, and probably the heaviest in May since 1858. The rains included several copious storms that swelled the streams into floods, and damaged the country largely by washing away bridges, culverts, and rendering roads impassable for a time.

The ground has been saturated with water for most of the month, that materially retarded or suspended most all farm-work. The planting is not all finished, and the corn and other crops that are up suffer from wet, weeds, and a want of culture that cannot be given; and, unless dry weather intervenes immediately, the prospect of the farmer will be anything but flattering.

The wheat-crop, on an average, will not be worth more than the cost of harvesting. Grass was never better. The fruit-crop has not so flattering an aspect as last month. Cherries, pears, and apples did not set well, in some localities, and much of the young fruit has dropped. Various causes are assigned for this, other than temperature, such as imperfect fertilization, caused by high winds, rains, &c.* The peach, however, is an exception, and the trees are bearing a large crop of young fruit.

Strawberries have been in market for several days, but the supply from home-products will not equal the demand, as the plant was materially damaged by the prolonged winter.

PAPER Q.

WAR DEPARTMENT, OFFICE OF THE CHIEF SIGNAL-OFFICER,
DIVISION OF TELEGRAMS AND REPORTS FOR THE
BENEFIT OF COMMERCE AND AGRICULTURE,
Washington, D. C., ———, 187—.

SIR: By direction of the Chief Signal-Officer of the Army, I have the honor to request that steps be taken in your organization to effect that all propositions, resolutions, or memorials relating to the duties of this Office, as increased by the act of Congress approved June 10, 1872, which may be brought before it, shall be referred to your committee, and that after such reference, your committee confer with this Office in relation to the matter before it, previous to making its recommendation to the organization, in order, by interchange of opinion and facts, to arrive at a full understanding of them. It is also requested that when any action may be taken by the organization on the above-named subjects, your committee will forward a statement or copy of it direct to this Office.

It is the object of this request to bring the different boards of trade, chambers of commerce, and agricultural societies into perfect understanding with this Office in reference to their views and wishes.

I am, sir, respectfully, yours,

GARRICK MALLERY,
Captain, First Infantry, and Brevet Lieutenant-Colonel, U. S. A.,
Acting Signal-Officer and Assistant.

Mr. ————,
Chairman of the Meteorological Committee of the ————

* Such defects occurred in some of the indigenous species of fruits. The effects, in some localities, are abnormal that they cannot be explained on the theory of temperature alone, and involve some intricate questions.

PAPER R.

WAR DEPARTMENT, OFFICE OF THE CHIEF SIGNAL-OFFICER,
DIVISION OF TELEGRAMS AND REPORTS FOR THE
BENEFIT OF COMMERCE AND AGRICULTURE,
Washington, D. C., July 1, 1872.

SIR: By direction of the Chief Signal-Officer of the Army, I have the honor to inform your society that the powers of this Office have been enlarged by the legislation of Congress at its recent session, in a section, a copy of which is hereto appended. He invites any suggestions or recommendations to perfect the system now established, and to make it more useful to those varied interests for whose benefit it is designed.

It is shown by experience that the best mode in which agricultural and horticultural societies can co-operate with this Office is by the appointment, on the part of each society, of a permanent committee to confer from time to time with the Chief Signal-Officer of the Army, and to take, in conjunction with him, such steps, or to recommend for the consideration of the society such action as may be deemed desirable. A large number of societies have given notice to this Office of the appointment of such committees, with statement of the names and residences of the chairman and members, but your organization has not responded to the suggestion to that effect heretofore made.

It is desired to be understood that no request is presented that the proposed committee shall take meteorological observations or make reports for the signal service, but that it is only designed to obtain practical co-operation, through correspondence and conference.

I am, sir, respectfully, yours,

GARRICK MALLERY,

Captain, First Infantry, Brevet Lieutenant-Colonel, U. S. A.,
Acting Signal-Officer and Assistant.

To _____,
Secretary of the _____.

PAPER S.

THE PRACTICAL USE OF METEOROLOGICAL REPORTS AND WEATHER-
MAPS.

The office division of telegrams and reports for the benefit of commerce is organized for the preparation, receipt, and use of these reports.

At every station three observations are taken daily, at the same moment of actual (not local) time for all stations, by the observer-sergeants of the signal service. The reports are immediately telegraphed to the office of the Chief Signal-Officer at Washington.

By a carefully arranged system of telegraphic operation, copies of the full reports of all stations thus transmitted to Washington, or of portions of them, are sent at the same time to many of the signal-service stations in principal cities and towns.

At each station so receiving a tabular report, one or more bulletins are published. The observations are made synchronously at the different stations, at the exact hours, 7.35 a. m., 4.35 p. m., and 11.00 p. m., Washington time.

The full reports from all stations are telegraphed to and received at Washington, translated from cipher, and published in the form of bulletins of reports by the hours of 9 a. m., 6 p. m., and 1 a. m., respectively, (Washington time.) The bulletins of reports are designated as follows: That published at 9 a. m., the "morning report;" that published at 6 p. m., the "afternoon report," and that published at 1 a. m., the "midnight report." The bulletins, wherever published, at Washington or elsewhere, exhibit the following particulars, viz: Height of barometer; change since last report; thermometer; change in last twenty-four hours; relative humidity, in per cent.; direction of wind; velocity of wind, in miles per hour; pressure of wind, in pounds per square foot; force of wind; amount of cloud; rain-fall since last report, in inches and hundredths, and state of weather.

The morning and afternoon reports (bulletins) are posted at each of the local signal-service offices, and at a number of other public places in the cities and towns to which they are transmitted.

They are always open for examination. At the more prominent stations, and those in principal cities, large weather-maps are also posted every morning, exhibiting, by means of changeable symbols, the reports of the morning observations at the different stations. The midnight report (bulletin) is gratuitously furnished to every morning newspaper published in the city at which a station of observation may be, which will insert it in its columns. The morning report is also delivered to afternoon papers in time for publication.

The observers at each station are instructed to afford every facility to the press and to the public for the earliest receipt and most extended use of the reports and information at their respective offices.

In addition to the bulletins, a statement of synopses and probabilities is prepared at the

office of the Chief Signal-Officer, and thence issued thrice daily. It is immediately furnished to the Associated Press, by which it is telegraphed to all its agencies throughout the country.

The synopses and probabilities, with which the public is familiar through the columns of the different newspapers, are issued from the office of the Chief Signal-Officer at 1 a. m., 10 a. m., and 7 p. m., daily.

In the study of local probabilities the student should make sure that he has before him (as in the columns of the local newspapers) the latest synopses and probabilities issued at Washington. To be sure of such facts, he must notice the hours at which they are dated from the office in Washington. *The midnight reports, dated at 1 a. m. of each day, ought to be found in the morning newspapers of that day. The morning report, dated at 10 a. m. of each day, is furnished in time for the afternoon and evening papers.*

At places where stations are established, the use of the bulletined reports, in the mode suggested in this paper, would often, perhaps, enable the student to make forecasts of the weather with greater local particularity than can be expressed in the "synopses and probabilities" telegraphed to the press, as the latter must, in a limited number of words, give generalizations embracing the whole country; and it is believed that, in many places distant from any station, but on or near the lines of railways or steamers, or with other mode of rapid communication, the bulletins can be utilized in a corresponding manner. IF, AT THE STATION NEAREST TO PERSONS INTERESTED, AS, FOR INSTANCE, THE BOARD OF TRADE, OR CHAMBER OF COMMERCE, OR METEOROLOGICAL COMMITTEE OF AN AGRICULTURAL SOCIETY, OR INDIVIDUALS INTERESTING THEMSELVES IN THE STUDY OF PRACTICAL METEOROLOGY, NO NEWSPAPER PRINTS THE BULLETINS FURNISHED GRATUITOUSLY BY THIS OFFICE FOR THAT PURPOSE, THERE IS A STRONG PROBABILITY THAT, UPON PROPER APPLICATION MADE TO THE EDITORS OR PROPRIETORS, THEY WOULD BE PRINTED, AS OF INTEREST TO THE SUBSCRIBERS AND READERS. In cases where delay would thereby be avoided, arrangements can often be made with the publisher to have copies of the newspaper containing bulletins sent in advance of its delivery by mail. By such means, and others which will suggest themselves, a record of meteorological conditions elsewhere can be obtained in many places within so few hours after the observations are taken at the different stations as to enable a student to make for himself many important deductions. The accuracy of these would be greatly assisted by local observations made at the same time as those of the observers of this division, with similar instruments, and by frequent local observations made during any time at which there is especial interest & anxiety as to the probable weather.

The navigator, the agriculturist, or the student can supplement in this way, by the readings of his own instruments and his local knowledge, the reports and information furnished by the United States, and is fitted to arrive at intelligent conclusions as to the *data* before him.

There is as yet no provision for furnishing instruments, on the part of the United States, to any other than the observer-sergeants, although it is possible that some such authority may hereafter be given. Full information as to the instruments and their use will, however, be furnished to all persons, who may provide them for themselves.

In addition to the weather-bulletins and the "synopses and probabilities," a graphic weather chart or map is issued thrice daily from the office of the Chief Signal-Officer of the Army, at the War Department. To those who know how to use them, all of these publications offer valuable help in estimating the probable character of the weather at any station, or over any district, during the following day, and often for a still longer period. The bulletins and graphic charts, properly filled, convey the same information, with this difference: while the former merely tabulate the reports alphabetically, the latter reveal to a single glance of the eye a synoptic view, at once, of the meteoric conditions at the different stations, and of the deductions thence to be made as to the conditions of the atmosphere then extending over the continent.

The graphic charts are of additional value, from the fact that it is often possible to trace upon them, in lines, the progress of storms, or the change of meteoric condition (as the movement of an area of high or low barometer) from report to report, and thus, by considering the past, and by applying laws and generalizations reasonably well established, to estimate more easily the "probability" of the future.

Those who receive the bulletin through the newspapers, or otherwise, can, if they desire so, easily transfer its information to the blank charts, that the reader is supposed to be in possession of, or familiar with, a series of such weather-maps.*

ABBREVIATIONS USED IN THE PRESS REPORTS.

It may be well to state here, that in the weather synopses and probabilities emanating from the Signal-Office, different parts of the country are thus designated:

Maine, New Hampshire, Vermont, Massachusetts, Connecticut, and Rhode Island, are alluded to as the *New England States* or the *Northeast*, or simply as the *Eastern States*.

* Blank charts on which to enter observations can be obtained from the Office of the Chief Signal-Officer, at Washington, D. C., at actual cost, (\$2.75 per hundred,) and will be sent by mail, free of other expense, to applicants.

New York, New Jersey, Pennsylvania, Maryland, District of Columbia, and Virginia as the *Middle States*, or sometimes as the *Middle Atlantic States*.

North Carolina, South Carolina, Georgia, and Northern and Eastern Florida, as the *South Atlantic States*.

Western Florida, Alabama, Mississippi, Louisiana, and Texas as the *Gulf States*.

Sometimes the Gulf States, the South Atlantic, Virginia, Tennessee, Kentucky, and Arkansas are grouped together as the *Southern States*.

The *Lower Lakes*, when used, mean Lake Erie and Ontario.

The *Upper Lakes* are Lakes Superior, Huron, and Michigan.

The *Northwest*, popularly, means the country lying between the Mississippi and Missouri Rivers.

The *Southwest* means Texas, Indian Territory, and New Mexico.

Pacific Coast or *Pacific States* includes California, Oregon, and Washington Territory.

The *Ohio Valley* includes the belt of country, about two hundred miles broad from Pittsburgh to Cairo.

The *Mississippi Valley* includes a belt, of about the same width, from Vicksburgh to Davenport.

The extensions "from Missouri to Ohio," &c., &c., refer to areas reaching to and including the central portions of the States named. Thus a report "Westerly winds extend ing from Iowa to Pennsylvania," would signify that those winds would be felt in the interior of those States as well as over the territory lying between them of the respective States.

In "*the Coasts, &c.*," is included the land between the coasts and the parallel range of coast hills or mountains. In Texas, Louisiana, and Northern Florida a belt of land extending a hundred miles inward would be included.

Winds are said to blow from northeast when they are generally included within the quadrant from north to east, &c., and similarly for other directions.

REPORT OF THE SECRETARY OF WAR.

PAPER T¹.WAR DEPARTMENT, OFFICE OF THE CHIEF SIGNAL-OFFICER,
DIVISION OF TELEGRAMS AND REPORTS FOR THE
BENEFIT OF COMMERCE AND AGRICULTURE.

[Working forms of circuit.]

CIRCUIT No. 1.—CHICAGO AND SAINT LOUIS.

Pacific and Atlantic Telegraph Company.

SAINT LOUIS TO CHICAGO.			CHICAGO TO SAINT LOUIS.		
At 7.06 a. m., 4.06 p. m., and 11.06 p. m., Davenport will send—	At 7.03 a. m., 4.03 p. m., and 11.03 p. m., Keokuk will send—	At 7.09 a. m., 4.09 p. m., and 11.09 p. m., Saint Louis will send reports from—	At 7.28 a. m., 4.28 p. m., and 11.28 p. m., Chicago will send reports from—		
To— Chicago.	Through— Davenport, To— Chicago.	Saint Louis, Cairo, Leavenworth, Through— Cairo, Davenport, To— Chicago.	Omaha, Cheyenne, Milwaukee, Cincinnati, Louisville, Memphis, Shreveport, Grand Haven, Cleveland, Buffalo, Saint Paul, Chicago, Davenport,	Indianapolis, Pittsburgh, Nashville, Vicksburg, Denver, New Orleans, Detroit, Toledo, Santa Fé, Fort Benton, Fort Sully, Through— Keokuk, To— Saint Louis.	

NOTES.

1. Each station will take down the reports sent by the others, in regular succession, so that when the last one finishes, all of them will have the full reports from the others.
2. Each intermediate station will take down the above reports as they pass over the line. Copies of these reports will be bulletined in the rooms of the different boards of trade and furnished to the local papers for publication.
3. The time given for sending reports is the local time of that particular station.

PAPER T².

WAR DEPARTMENT, OFFICE OF THE CHIEF SIGNAL-OFFICER,
DIVISION OF TELEGRAMS AND REPORTS FOR THE
BENEFIT OF COMMERCE AND AGRICULTURE.

[Working forms of circuit.]

CIRCUIT No. 2.—CINCINNATI AND CHICAGO.

Pacific and Atlantic Telegraph Company.

CHICAGO TO CINCINNATI.		CINCINNATI TO CHICAGO.	
At 7.24 a. m., 4.24 p. m., and 11.24 p. m., Indianapolis will send—	At 7.19 a. m., 4.19 p. m., and 11.19 p. m., Chicago will send reports from—		At 7.35 a. m., 4.35 p. m., and 11.35 p. m., Cincinnati will send reports from—
	Chicago, Davenport, Omaha, Fort Sully, Saint Louis, Saint Paul, Keokuk, Leavenworth, Through— Indianapolis, To— Cincinnati.	Cairo, Fort Benton, Milwaukee, Detroit, Buffalo, Grand Haven, Toledo, Cleveland, Through— Indianapolis, To— Cincinnati.	Cincinnati, Pittsburgh, Louisville, Nashville, Shreveport, Memphis, Vicksburg, New Orleans, Through— Indianapolis, To— Chicago.
To— Cincinnati.			

NOTES.

1. Each station will take down the reports sent by the others, in regular succession, so that when the last one finishes, all of them will have the full reports from the others.
2. Each intermediate station will take down the above reports as they pass over the line. Copies of these reports will be bulletined in the rooms of the different boards of trade, and furnished to the local papers for publication.
3. The time given for sending reports is the local time of that particular station.

REPORT OF THE SECRETARY OF WAR.

PAPER T³.

WAR DEPARTMENT, OFFICE OF THE CHIEF SIGNAL-OFFICER,
DIVISION OF TELEGRAMS AND REPORTS FOR THE
BENEFIT OF COMMERCE AND AGRICULTURE.

[Working forms of circuit.]

CIRCUIT No. 3.—WASHINGTON AND CINCINNATI.

Pacific and Atlantic Telegraph Company.

CINCINNATI TO WASHINGTON.		WASHINGTON TO CINCINNATI.
At 7.48 a. m., 4.48 p. m., and 11.48 p. m., Pitts- burgh will send—	At 7.31 a. m., 4.31 p. m., and 11.31 p. m., Cin- cinnati will send re- ports from—	
To— Washington.	Cincinnati, Davenport, Omaha, Fort Sully, Saint Louis, Louisville, Memphis, New Orleans, Saint Paul, Keokuk, Leavenworth, Fort Benton, Cairo, Nashville, Vicksburg, Shreveport, Through— Pittsburgh, To— Washington.	

NOTES.

1. Each station will take down the reports sent by the others, in regular succession, so that when the last one finishes, all of them will have the full reports from the others.
2. Each intermediate station will take down the above reports as they pass over the line. Copies of these reports will be bulletined in the rooms of the different boards of trade, and furnished to the local papers for publication.
3. The time given for sending reports is the local time of that particular station.

PAPER T⁴.

WAR DEPARTMENT, OFFICE OF THE CHIEF SIGNAL-OFFICER,
DIVISION OF TELEGRAMS AND REPORTS FOR THE
BENEFIT OF COMMERCE AND AGRICULTURE.

[Working forms of circuit.]

CIRCUIT No. 4.—CINCINNATI AND NEW ORLEANS.

Pacific and Atlantic Telegraph Company.

NEW ORLEANS TO CINCINNATI.				CINCINNATI TO NEW ORLEANS.	
At 7.23 a. m., 4.23 p. m., and 11.23 p. m., Louisville will send—	At 7.22 a. m., 4.22 p. m., and 11.22 p. m., Nashville will send—	At 7.10 a. m., 4.10 p. m., and 11.10 p. m., Memphis will send—	At 7.11 a. m., 4.11 p. m., and 11.11 p. m., New Orleans will send reports from—	At 7.35 a. m., 4.35 p. m., and 11.35 p. m., Cincinnati will send reports from—	
To— Cincinnati.	Through— Louisville, To— Cincinnati. A	Through— Nashville, Louisville, To— Cincinnati.	New Orleans, Vicksburg, Shreveport, Through— Memphis, Nashville, Louisville, To— Cincinnati.	Cincinnati, Saint Paul, Omaha, Fort Sully, Saint Louis, Pittsburgh, Chicago, Davenport, Keokuk, Leavenworth, Fort Benton, Cairo, Through— Louisville, Nashville, Memphis, To— New Orleans.	

NOTES.

1. Each station will take down the reports sent by the others, in regular succession, so that when the last one finishes, all of them will have the full reports from the others.

2. Each intermediate station will take down the above reports as they pass over the line. Copies of these reports will be bulletined in the rooms of the different boards of trade, and furnished to the local papers for publication.

3. The time given for sending reports is the local time of that particular station.

REPORT OF THE SECRETARY OF WAR.

PAPER T⁹.

WAR DEPARTMENT, OFFICE OF THE CHIEF SIGNAL-OFFICER,
DIVISION OF TELEGRAMS AND REPORTS FOR THE
BENEFIT OF COMMERCE AND AGRICULTURE.

[Working forms of circuit.]

CIRCUIT No. 1.—MARQUETTE AND MILWAUKEE.

Northwestern Telegraph Company.

MARQUETTE TO MILWAUKEE.		MILWAUKEE TO MARQUETTE.
At 7.10 a. m., 4.10 p. m., 10.34 p. m., Marquette will send reports, through—	At 7.10 a. m., 4.10 p. m., 10.35 p. m., Escanaba will send reports—	
Escanaba To— Milwaukee.	To— Milwaukee.	

NOTES.

1. Each station will take down the reports sent by the others, in regular succession, so that when the last one finishes, all of them will have the full reports from the others.
2. Each intermediate station will take down the above reports as they pass over the line. Copies of these reports will be bulletined in the rooms of the different boards of trade, and furnished to the local papers for publication.
3. The time given for sending reports is the local time of that particular station.

PAPER T¹⁰.

WAR DEPARTMENT, OFFICE OF THE CHIEF SIGNAL-OFFICER,
DIVISION OF TELEGRAMS AND REPORTS FOR THE
BENEFIT OF COMMERCE AND AGRICULTURE.

[Working forms of circuit.]

CIRCUIT No. 2.—SAINT PAUL AND MILWAUKEE.

Northwestern Telegraph Company.

SAINT PAUL TO MILWAUKEE.	MILWAUKEE TO SAINT PAUL.
At 6.51 a. m., 3.51 p. m., 10.16 p. m., Saint Paul will send reports from—	
Saint Paul, Du Luth, Breckenridge, To— Milwaukee.	

NOTES.

1. Each station will take down the reports sent by the others, in regular succession, so that when the last one finishes, all of them will have the full reports from the others.
2. Each intermediate station will take down the above reports as they pass over the line. Copies of these reports will be bulletined in the rooms of the different boards of trade, and furnished to the local papers for publication.
3. The time given for sending reports is the local time of that particular station.

PAPER T¹¹.

WAR DEPARTMENT, OFFICE OF THE CHIEF SIGNAL-OFFICER,
DIVISION OF TELEGRAMS AND REPORTS FOR THE
BENEFIT OF COMMERCE AND AGRICULTURE.

[Working forms of circuit.]

CIRCUIT No. 3.—DU LUTH AND SAINT PAUL.

Northwestern Telegraph Company.

DU LUTH TO SAINT PAUL.	SAINT PAUL TO DU LUTH.
At 6.50 a. m., 3.50 p. m., and 10.15 p. m. Du Luth will send reports—	
To— Saint Paul.	

NOTES.

1. Each station will take down the reports sent by the others, in regular succession, so that when the last one finishes, all of them will have the full reports from the others.
2. Each intermediate station will take down the above reports as they pass over the line. Copies of these reports will be bulletined in the rooms of the different boards of trade, and furnished to the local papers for publication.
3. The time given for sending reports is the local time of that particular station.

PAPER T¹².

WAR DEPARTMENT, OFFICE OF THE CHIEF SIGNAL-OFFICER,
DIVISION OF TELEGRAMS AND REPORTS FOR THE
BENEFIT OF COMMERCE AND AGRICULTURE.

[Working forms of circuit.]

CIRCUIT No. 4.—BRECKENRIDGE AND SAINT PAUL.

Northwestern Telegraph Company.

BRECKENRIDGE TO SAINT PAUL.	SAINT PAUL TO BRECKENRIDGE.
At 6.31 a. m., 3.31 p. m., and 9.56 p. m., Breckenridge will send reports—	
To— Saint Paul.	

NOTES.

1. Each station will take down the reports sent by the others, in regular succession, so that when the last one finishes, all of them will have the full reports from the others.
2. Each intermediate station will take down the above reports as they pass over the line. Copies of these reports will be bulletined in the rooms of the different boards of trade, and furnished to the local papers for publication.
3. The time given for sending reports is the local time of that particular station.

REPORT OF THE SECRETARY OF WAR.

PAPER T¹³.WAR DEPARTMENT, OFFICE OF THE CHIEF SIGNAL-OFFICER,
DIVISION OF TELEGRAMS AND REPORTS FOR THE
BENEFIT OF COMMERCE AND AGRICULTURE.

[Working forms of circuit.]

CIRCUIT No. 5—FORT SULLY AND OMAHA.

Northwestern Telegraph Company.

FORT SULLY TO OMAHA.	OMAHA TO FORT SULLY.
At 6.15 a. m., 3.15 p. m., and 9.40 p. m., Fort Sully will send reports—	
To— Omaha.	

NOTES.

1. Each station will take down the reports sent by the others, in regular succession, so that when the last one finishes, all of them will have the full reports from the others.
2. Each intermediate station will take down the above reports as they pass over the line. Copies of these reports will be bulletined in the rooms of the different boards of trade, and furnished to the local papers for publication.
3. The time given for sending reports is the local time of that particular station.

PAPER Z.

WEEKLY WEATHER CHRONICLE.

WAR DEPARTMENT, OFFICE OF THE CHIEF SIGNAL-OFFICER,
DIVISION OF TELEGRAMS AND REPORTS FOR THE
BENEFIT OF COMMERCE AND AGRICULTURE,
Washington, D. C., October 31, 1872.

GENERAL SUMMARY FOR THE WEEK ENDING THURSDAY, OCTOBER 31, 1872.

Two extensive rain-storms have prevailed during the past week, the one moving northward over the Atlantic States, with very rough weather from Florida to Cape Cod, the other advancing northeastward over Kansas, Nebraska, and Minnesota into Canada, its rain-belts extending far to the southward and eastward.

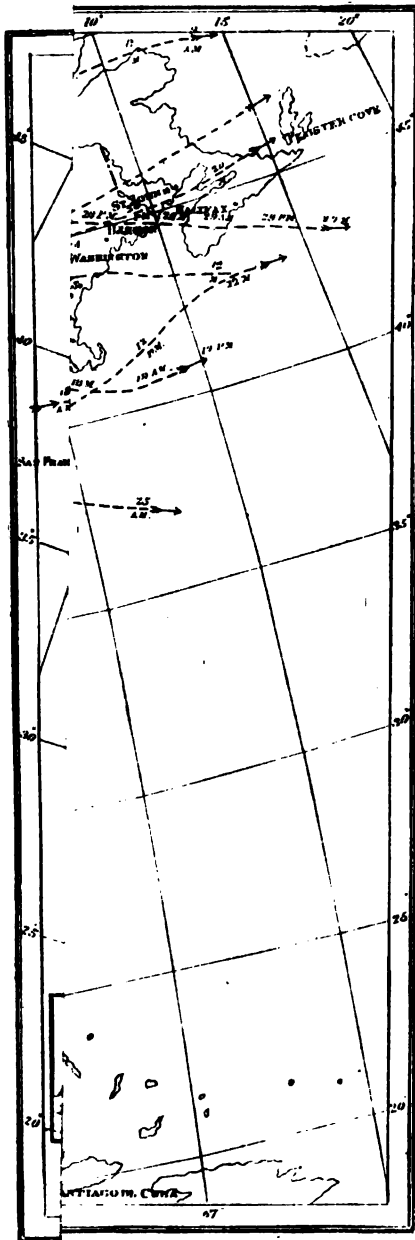
Thursday, 24.—The storm which had advanced from Florida continued central over the eastern portions of the Carolinas, moving slowly northward; brisk northeasterly winds and heavy rains prevailed thence along the coast to Connecticut; increasing cloudiness, followed by light rain, over the Ohio Valley and the Lower Lake region; clear weather from the Missouri Valley to the Upper Lakes.

Friday.—The storm slowly continued its northward movement over the eastern portions of North Carolina and Virginia, brisk and high northeasterly winds and heavy rains prevailing thence to New York; cloudy weather, with light rain, from Kentucky to Michigan and the Lower Lakes; continued clear weather from the Lower Mississippi Valley to Lake Michigan and westward; clearing and clear weather over the South Atlantic and Gulf States.

Saturday.—The morning reports locate the storm-center in Pennsylvania, the afternoon in New York, northerly and easterly winds and heavy rains prevailing thence to the New England coast; westerly and northwesterly winds, with light rains, from Michigan to Western Pennsylvania, and with clearing weather from Indiana and Kentucky to Chesapeake Bay; generally clear weather over the Southern States and the Northwest.

Sunday.—By morning the storm-center had moved eastward to the coast of Maine. Light rains continued over the Lower Lake region and Middle and Eastern States, with brisk northeasterly winds on Lake Ontario, and in the evening on the New England coast, followed at night by rapidly rising barometer and clearing weather.

Monday.—Cloudy weather prevailed from West Virginia to Lake Erie and eastward to the Atlantic, with light rains and brisk northeasterly winds along the coast from North Carolina to Connecticut, succeeded during the evening by clear weather north of Virginia. Clear and



AM PHOTO LITHOGRAPHIC CO N.Y. (OSBORNE'S PROCESS)

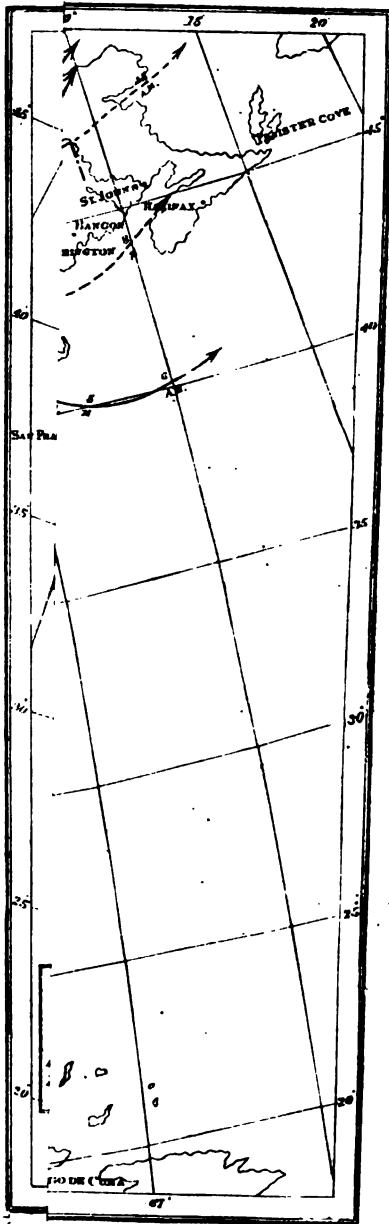
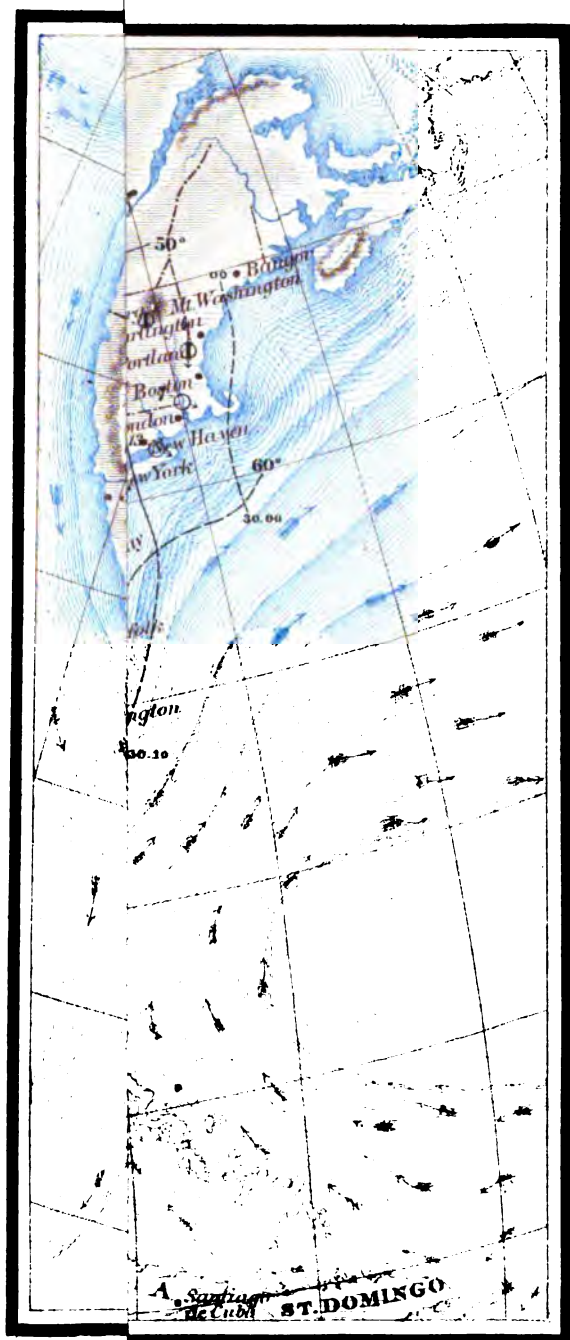
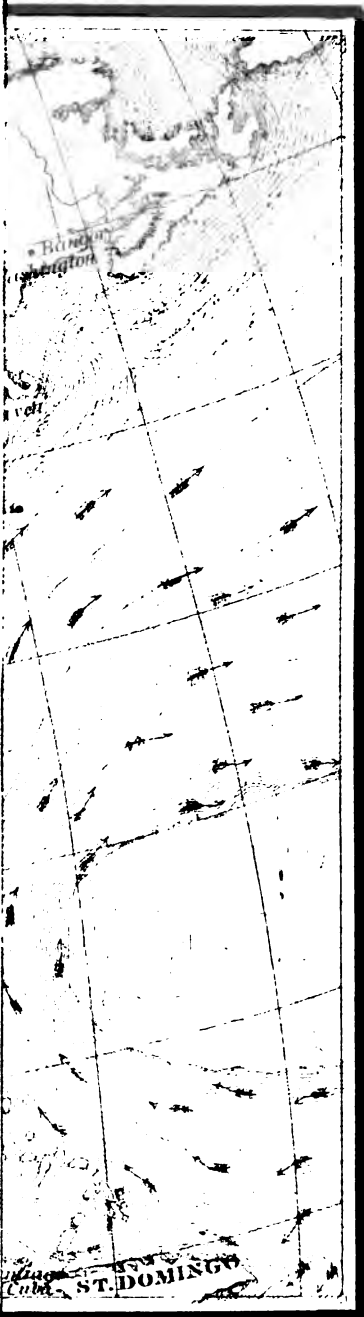


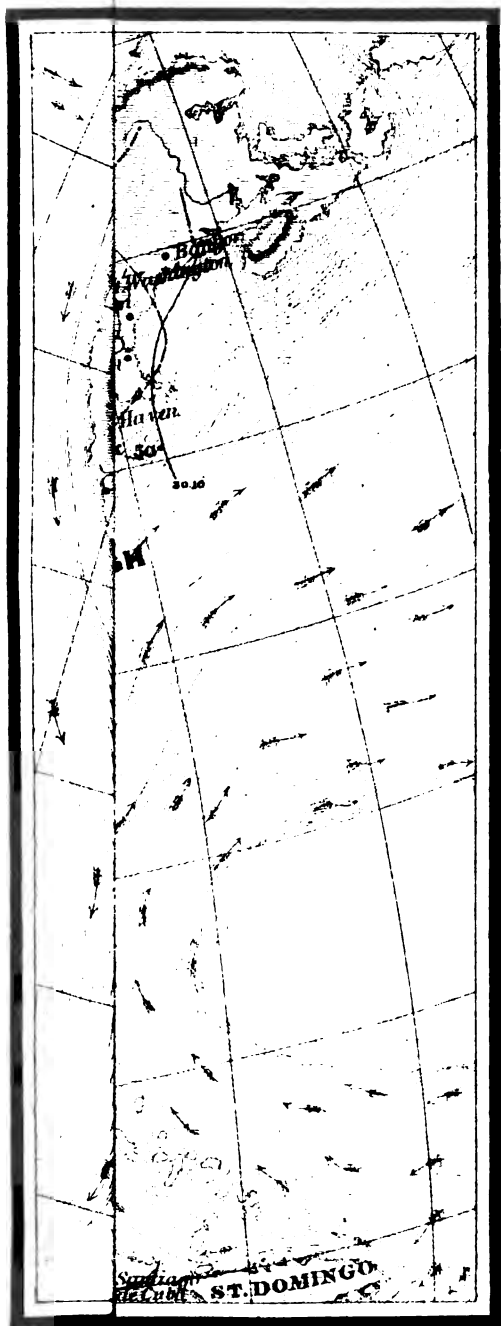
PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORN'S PROCESS)





AM. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS.)







cold weather was reported from Northern New York and New England, and generally clear weather from the Southern States; falling barometer, with brisk and high southeasterly and easterly winds and occasional rain from the northwest; heavy snow from Colorado and Wyoming Territories.

Tuesday.—In the morning very high barometer and clear weather, with frosts, prevailed over the Lower Lake region and the Middle and Eastern States; partly cloudy weather in the Southern States, with brisk northeasterly winds on the South Atlantic coast; heavy rains from Northern Louisiana and Texas to Dakota; the storm-center in Kansas and Nebraska moved northeastward during the day and evening to Iowa and Minnesota, preceded by cloudy weather, light rains, and brisk and high easterly to southerly winds thence to the Upper Lakes and Indiana. Clear and cold weather was reported in the morning from the Rocky Mountains, the temperature being 20° at Denver and 17° at Cheyenne.

Wednesday.—The storm, in the morning central in Minnesota, continued its northeastward course during the day and evening, passing into Canada. Cloudy weather and rain prevailed from Minnesota and the Upper Lakes to the Ohio Valley and thence southward to the Gulf; clearing and clear weather extending eastward to the Mississippi. Generally clear weather continued over the Middle and Eastern States; prevailing cloudiness over the South Atlantic.

Thursday.—In the morning cloudy and threatening weather, with light rain, was reported from Lakes Michigan and Erie southward to the Eastern Gulf and South Atlantic coasts; cool and partly cloudy weather from the Middle States and New England; clearing and clear weather from the Mississippi Valley and westward.

During the past week rain has fallen at all of the stations, excepting, probably, Southern California and the peninsula of Florida. The largest total amounts reported are: From New York, 1.99 inches; Baltimore, 2.01; Pittsburgh, 2.22; Shreveport, Louisiana, 2.73; Rochester, 2.94; Washington, 3.45; Omaha, 3.80; Philadelphia, 4.13; and Norfolk, 6.58.

Published by order of the Secretary of War.

Furnished for the use of the—

PAPER A¹.—[FORM 15.]

[This official report is furnished the press with the explicit understanding that it shall not be altered or garbled, and that any paper using it at all will follow the precise wording given below the line. There is danger that incorrect or altered reports may greatly mislead the public, and bring discredit upon the service. Editors are requested to insist upon the accurate following of the copy.]

WAR DEPARTMENT, OFFICE OF THE CHIEF SIGNAL-OFFICER,

Washington, D. C., Friday, September 20, 1872—8. p. m.

Del'd 7.32 p. m.—Craig.

SYNOPSIS FOR THE PAST TWENTY-FOUR HOURS.

The low barometer, which on Thursday afternoon was over Northeastern New York, has moved eastward over and beyond the northern portion of New England, followed by fresh and brisk northwesterly winds from the Lower Lakes to the East and Middle Atlantic coasts. The pressures have diminished north and west of the Ohio Valley, and a second area of low barometer has advanced eastward to, probably, the southwestern portion of Minnesota and western portion of Iowa, accompanied by fresh to very brisk winds. A high northeasterly wind is reported from Escanaba. Clear weather is generally prevailing from the Mississippi to the Atlantic. The temperature has fallen, somewhat, over the South Atlantic States, but decidedly risen from Tennessee and Kentucky to the northwest.

PROBABILITIES.

For the New England and Middle States, on Saturday, clear weather and rising temperature, with westerly and southwesterly winds over the former, and southerly and southeasterly winds over the latter. For the South Atlantic States, clear weather and easterly to southerly winds. For the Gulf States, southerly winds and generally clear weather. From Tennessee to Lake Erie and Lower Michigan, increasing southerly winds and cloudiness, and probably threatening weather. Southerly gales are probable for Lake Michigan to-night, shifting to northwesterly during Saturday morning. Brisk and very brisk southerly winds for Lakes Erie and Huron during Saturday, and for Lake Ontario, probably, Saturday evening. For the Northwest, on Saturday, northerly to westerly winds and clearing weather.

WARNING-SIGNALS ORDERED.

Cautionary signals are ordered for Milwaukee, Chicago, and Grand Haven.

PAPER B¹.—FORM 4.
WAR DEPARTMENT, SIGNAL-SERVICE UNITED STATES ARMY,
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.
Meteorological record for the week ending ———, 187—

Day and date of observation	Time of observation.	Barometer.	THERMOMETER.		Corrected barometer.	HYGROMETER.		Relative humidity.	WIND.				UPPER CLOUDS.				RAIN OR SNOW.		Amount of rain or melted snow.	Change in river, (+ or -).	Maximum and minimum thermometer.	MEAN.		REMARKS.
			Attached.	Exposed.		Dry bulb.	Wet bulb.		Direction.	Velocity per hour.	Pressure per sq. foot.	Daily velocity.	Kind.	Amount.	Direction, (moving from—)	Commenced.	Ended.	Barometer.				Thermometer.		
Sunday ...	a. m. p. m. m.																							
Monday ...	a. m. p. m. m.																							
Tuesday ...	a. m. p. m. m.																							
Wednesday	a. m. p. m. m.																							
Thursday ..	a. m. p. m. m.																							
Friday	a. m. p. m. m.																							
Saturday ..	a. m. p. m. m.																							

Station ———

Observer. ———

PAPER C'.—FORM 5.

WAR DEPARTMENT, SIGNAL-SERVICE UNITED STATES ARMY,
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE.

Report of observations taken at ———, on ———, at ———.

1					
2					

Received at ——— M.

Sent at ——— M.

—————, *Observer.*

—————, *Operator.*

NOTE.—All reports on this form will be made in two lines of five words each, except the *afternoon* reports from river-stations, which will be in two lines of six words each. Operators will send only the matter inside the heavy lines, without address or signature.

PAPER D'.—FORM 24.

*Record of bulletins, maps, and press reports, issued during the week ended ———, 1872,
at ———.*

Day.	Number of bulletins.				Number of press reports.			Remarks.
	Morning.	Afternoon.	Midnight.	Number of maps	Morning.	Afternoon.	Midnight.	
Sunday								
Monday ..								
Tuesday ...								
Wednesday.								
Thursday ..								
Friday								
Saturday ...								
Total								

Observer.

PAPER E¹.—FORM 25.

WAR DEPARTMENT, SIGNAL SERVICE UNITED STATES ARMY,
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE,
Telegram.] _____, _____, 187-, ____m.

CHIEF SIGNAL-OFFICER.
Washington :

NOTE.—Only the matter between the heavy lines to be transmitted.

REPORT OF THE SECRETARY OF WAR.

PAPER F¹.—FORM 26.

OFFICE OF OBSERVATION, SIGNAL-SERVICE, UNITED STATES ARMY.

Daily report of the stage of water, with changes in the twenty-four hours ended 3 p. m. ———
 ———, 187—.

	Above low water.		Changes.			
			Rise.		Fall.	
	<i>Feet.</i>	<i>Inches.</i>	<i>Feet.</i>	<i>Inches.</i>	<i>Feet.</i>	<i>Inches.</i>
Saint Paul
Fort Benton
Omaha
Davenport
Leavenworth
Keokuk
Cairo
Saint Louis
Pittsburg
Cincinnati
Louisville
Memphis
Vicksburg
Shreveport
Nashville
New Orleans
.....

Observer, Signal-Service, United States Army.

PAPER G¹.—FORM A.

WAR DEPARTMENT, OFFICE OF THE CHIEF SIGNAL-OFFICER,
DIVISION OF TELEGRAMS AND REPORTS FOR THE
BENEFIT OF COMMERCE AND AGRICULTURE.

Report of Government messages refused by — Telegraph Company during the week ending —, 187, at —.

Date.	Time of tendering message.	Nature of message.	Name of operator refusing message.	Remarks.

I certify that the above statement is correct, and that the messages were tendered by me and refused at the hours named.

Observer, Signal-Service, U. S. A. •

PAPER I'.—FORM C.

SIGNAL-SERVICE, UNITED STATES ARMY,
Observer's Office, ———, ———, 187—.

To ———,

Manager of the ——— Telegraph Company at ——— :

SIR: As an agent of the War Department for the purpose of taking meteorological observations, in pursuance of the laws of the United States, and of preparing telegraphic communications relating thereto, and of presenting the same for transmission to telegraph companies, I have the honor to give notice hereby that, in accordance with orders received by me to that effect, I will present at the office of the above-mentioned telegraph company at this place, severally, at the times hereinafter mentioned, certain official communications from myself, in my official capacity, and addressed as specified, viz:

One communication will be presented at — o'clock — minutes — m. of — the — day of —, 1872, addressed to —.

One communication will be presented at — o'clock — minutes — m. of — the — day of —, 1872, addressed to —.

One communication will be presented at — o'clock — minutes — m. of — the — day of —, 1872, addressed to —.

I have the honor to request that the communications above referred to may be received and transmitted telegraphically by the said company to their respective addresses at the times above mentioned, at which they will severally be presented for that purpose.

I am, sir, respectfully, yours,

—————,
Observer-Sergeant, Signal-Service, U. S. A.

PAPER J¹.

Station : _____.

Date : _____, 187-.

Observations.	Local, (local time)		7 a.m.	2 p.m.	9 p.m.
	Telegraphic (Washington time)		a.m.	p.m.	p. m.
Barometer.	Observed height				
	Attached thermometer				
	Correction for temperature				
	Barometer : Corrected for temperature				
	Correction for elevation				
	Barometer : Corrected for elevation				
	Instrumental error				
	Barometer corrected				
Hygrometer.	Dry bulb				
	Wet bulb				
	Relative humidity				
Thermometer.	Exposed				
	Maximum				
	Minimum				
	Direction (from) and character				
Wind.	Anemometer, 1st reading				
	Anemometer, 2d reading				
Clouds.	Upper.	Kind			
		Amount in fourths			
		Direction (from) and velocity			
	Lower.	Kind			
		Amount			
		Direction and velocity			
Weather.	Began, ended, and amount in inches.	Washington time.	Rain		
			Hail		
			Snow		
			Sleet		
River-gauge.	Observed height				
	Change in 24 hours				

UNITED STATES MILITARY ACADEMY.

50 w



REPORT
OF THE
SUPERINTENDENT OF U. S. MILITARY ACADEMY.

UNITED STATES MILITARY ACADEMY,
West Point, New York, October 5, 1872.

SIR: I have the honor to submit the following report relative to the Military Academy.

The discipline of the Academy has, since last annual report, continued in a generally satisfactory condition; no serious exceptions requiring special mention having occurred. The state of instruction is good, and has apparently improved since last report. The professors of the different departments, and their assistants, have been faithful in the performance of duty. The condition as to studiousness of cadets has also been satisfactory, particularly as to those (always a considerable per cent. in all schools) who study little more than circumstances compel.

The immediate wants of the departments of instruction will be supplied if the appropriations asked for the ensuing fiscal year shall be granted. The principal sum required is for the department of philosophy, which needs apparatus for field instruction necessary to fit graduates for the duty of conducting surveys, &c., and better means for optical and acoustical illustration. In the department of practical engineering considerable improvement has been made during the past year. When changes now contemplated are effected, the instruction in this department will be as nearly complete as the necessities of other branches will permit. No changes made or contemplated as to the other departments of instruction, and to which your attention has already been given, call for special remark in this report.

With reference to the subject of instruction generally, I would invite attention to the views stated following, and which, for the most part, I entertained at the time of presenting last year's report, but thought best not to offer in an official form so soon after entering upon duty at the Academy, nor unless confirmed by further consideration. The subjects of study at the Military Academy embrace all that is essential and nearly all that is necessary to the education of an officer of the Army; the methods of instruction, as to which some further remarks will be offered herein, are thorough, and well designed to bring the average attainment of cadets in the subjects taught to a high standard, and to force on those least studious, or having little aptitude, the alternative of making sufficient effort to attain the standard required or separating from the Academy. The result has been that the Military Academy as a training-school for officers of the Army has been practically successful as to studies as well as discipline. This result has, however, been due much less to the character of the students than that of the professors and military officers connected with the institution, and the system of instruction pursued, and, properly considered, is only proof of what has

been accomplished with classes furnished without tests adequate to distinguish those possessed of aptitude, intelligence, and desire for study, from the generally indifferent. That a better general result can be effected by the Academy than is possible under existing laws, is evident on slight examination.

The nation, I believe, has not been, nor can it be expected that it will be, served by a body of officers more devoted to duty and efficient in their office than the professors at the Military Academy; nor can it reasonably be expected that any change which may be possible in the system of instruction would give any general result decidedly for the better; from which it is seen that suitable care in the selection of material, in any event the most ready, is also the only practicable means whereby the standard for graduates can be effectively raised. In this connection attention is invited to the following data:

The whole number admitted as cadets at the Military Academy from 1846 to 1866, (when some change, referred to below, as to qualifications for admission was enacted,) a period of twenty-one years, was 1,731, of which number 921 were graduated. Of those admitted, and who failed to graduate, by far the greater part failed for lack of proficiency in studies, and, for the most part, during the first year after admission. The large per cent. of failures must have been due to a standard unsuitably high, or material furnished not well selected therefor. That the standard was too high, no one having knowledge of the matter will say. The great loss of labor expended on so much unsuitable material, and having for invariable ending the failure of large numbers of incompetents and idlers, was a serious evil, but less so than the accompanying one, that a considerable per cent. that passed as qualified, did so under constant pressure.

To remedy in some degree the evils of too little requirement for admission, and supply as far as possible the necessities of the case, resulting from the exclusion of such subjects from the course of instruction, the act of June 16, 1866, was passed, adding to the qualifications for admission theretofore required, knowledge of the elements of English grammar, of descriptive geography, particularly of the United States, and of the history of the United States. Since this act has been in force, two classes admitted under its provisions have been graduated. The class which will have graduated in June next has sustained most if not all its loss, and may, for the purpose of comparison, be included with the two preceding in estimating the effect of the additional qualifications.

The whole number of appointments for the twenty-one years ending with the year 1866, was 2,164. Of this number, as before stated, there were 1,731 admitted, and 921 graduated, or 42½ per cent. of those appointed finally passed through the course of instruction. For the three years to be comparatively considered since the act referred to has been in operation, the whole number of appointments was 323, and the number of graduates, including the present first class, 142, or 44 per cent. of selections by appointment, finally succeeded, a result varying very little from that had before the passage of the act referred to. The standard of attainment after admission has remained substantially the same, and the conclusion is, that such additional requirement for admission has not had for a result any particular improvement in the character of appointments, and consequently no beneficial result as to the average attainment of graduates; which conclusion is confirmed by the opinion of those best qualified to judge.

The application of additional requirements for admission has not pro-

duced any marked improvement as to the character of graduates, for the reason that the subjects added to the test for admission are of the elementary character of those formerly applied, and no more assure, as to those admitted, any but a meager degree of attainment, or serve as a test of aptitude or inclination for study. The only marked effect for the better has been a greater number of rejected candidates from the increased number of subjects on which examinations for admission are based, who otherwise would have been admitted, to be discharged at the first examination thereafter. Should the standard for admission be raised sufficiently, with a view of obtaining a superior class of admissions, it would secure as to those admitted a much greater degree of acquirement, aptitude, and inclination for study than is now the case, but would inevitably, the present system of appointment continuing, result in the reduction of the classes to a fraction of their present and desirable numbers. Any method of selection that will assure suitable material, and classes sufficient in numbers, must, I believe, be based on some system of competitive examination which shall insure the selection of the best qualified from those who desire to enter the Academy.

The details of such a system I will not assume herein to suggest, but they should embrace due advertisement as to time, place, and subjects of examination, and insure competent and impartial examiners. The beneficial effect of the competitive system of selection is shown by the result in the case of the few cadets now at the Academy so selected, but not under common methods, and with reference only to the qualifications for admission now in force. The average standing of such cadets is in the first half of their respective classes.

There would be much in labor and expenditure saved by the adoption of a method of selection by which comparatively few appointed would fail to graduate. The advantage gained in the respects named would, however, be trivial in value to the nation, compared with that resulting from the selection of candidates possessing, as a rule, superior aptitude and intelligence.

The principal objections urged against the competitive system of selection are—

1st. That the facilities of education not being equal in all parts of our common country, some parts would profit at the expense of others. This objection is based on the assumption that in some States competent applicants would not be found, and consequently that the equal distribution of appointments necessary to be maintained, on grounds of public policy, if no other, could not be continued. The objection does not, when examined, appear to have any foundation. There is no congressional district in any State, nor, I believe, any Territory, in which young men are not constantly preparing for and entering colleges which require, preparatory to admission, attainment in studies greater than required for the Military Academy, represented by an equivalent of from one to two years' systematic study. That of such young men, none in some districts would accept the offer of the Government is highly improbable.

2d. It is objected, also, that under a competitive system of selection the sons of poor parents would not have equal chances with others. This objection is merely plausible. If by poor parents is intended destitute parents, the objection would no doubt apply, as it does in fact to the present, or would to any method of appointment not specially designed in favor of such youths, but it cannot properly be applied to the sons of parents whose circumstances compel effort for support, as

schools, the country over, contain a due proportion of young men whose parents have little means, or are in moderate circumstances.

Young men emulous and able to succeed under a system of competitive selection would as often be found the sons of such parents as otherwise. In any event, the competitive plan would give results depending more directly on the sons themselves than parents or others, which is exactly the end desirable in the premises.

It is also pertinent, in this connection, to consider that the Military Academy was not instituted nor is maintained as a national charity or bounty, but for the specific purpose of providing, for the nation's benefit, a certain number of professionally well educated military officers.

To the requirements for admission should be added knowledge of so much of algebra as includes quadratic equations, and plane geometry. This greater preliminary requirement and higher grade of admission would, in addition to advantages mentioned, permit the introduction of greater development of branches now taught without increasing the length of the course.

The improvements of first necessity, and to provide means for which appropriations are asked for the coming fiscal year, are:

1st. A hospital building for cadets;

2d. A system of sewerage;

3d. Quarters for laundresses belonging to the engineer company.

The particular necessity of appropriations for these objects is set forth in detail in the letter accompanying the estimate for the coming year, and to which attention in this connection is invited.

I would also respectfully invite attention to the necessity for legislation to place the Military Academy band upon a proper footing. This is the only band in the Army now authorized and provided for by law, and should on that account, as well as for other evident reasons, be kept in creditable condition. It has for the past few years been difficult to keep the band supplied with suitable material, owing to the much greater pay which even ordinary musicians could constantly obtain in New York and other cities. As now organized, the band consists of twenty-four musicians, divided into three classes—one-fourth receiving \$34 per month, one-fourth \$20, and the remaining half \$17. It is not possible to keep the band in proper condition on this footing, as it has become impossible to obtain the services of musicians at all suitable on the pay of \$17 per month. I would recommend as follows: That the band be composed of one teacher, as now, a civilian, at \$100 per month, (a suitable one cannot be had for less,) and forty enlisted musicians, one-fourth to receive, as now, \$34 per month, and the remainder \$30 per month. On this footing the band could be brought to and maintained in a suitable condition.

Respectfully submitted.

THOMAS H. RUGER,

Colonel Eighteenth Infantry, Superintendent.

The Honorable the SECRETARY OF WAR,

Washington, D. C.

**REPORT OF THE BOARD OF VISITORS OF THE
UNITED STATES MILITARY ACADEMY.**

**OFFICERS AND PROFESSORS ON DUTY AT THE UNITED STATES MILITARY
ACADEMY, SEPTEMBER 1, 1872.**

Name.	Rank and regiment.	Duties.
Thomas H. Ruger	Colonel Eighteenth Infantry	Superintendent.
Emory Upton	Lieutenant-colonel First Artillery ..	Commandant of cadets.
Albert E. Church, LL. D.	Professor of mathematics	
Robert W. Weir, N. A.	Professor of drawing	
Henry L. Kendrick, LL. D.	Professor of chemistry, &c.	
Patrice de Janon	Professor of Spanish	
Peter S. Michie, Ph. D.	Professor of philosophy	
George L. Andrews	Professor of French	
John Forsyth, D. D.	Chaplain, and professor of ethics and law.	
Junius B. Wheeler	Professor of engineering	Post surgeon.
Thomas A. McParlin	Surgeon medical department	Assistant instructor of infantry tac- tics.
Joseph S. Conrad	Captain Second Infantry	Adjutant.
Robert H. Hall	Captain Tenth Infantry	Quartermaster.
James M. Marshall	First lieutenant Fourth Artillery ..	Assistant instructor of artillery tac- tics. Treasurer.
John Egan	Captain Fourth Artillery	Instructor of practical military en- gineering.
Oswald H. Ernst	Captain Engineers	Assistant professor of philosophy.
Charles W. Raymond	Captain Engineers	Assistant instructor of cavalry tac- tics.
Alfred E. Bates	Captain Second Cavalry	Instructor of ordnance and gunnery.
John R. McGinniss	Captain Ordnance	Assistant professor of engineering.
Alexander M. Miller	Captain Engineers	Assistant post surgeon.
Jenkins A. Fitzgerald	Assistant surgeon medical depart- ment.	
James W. Reilly	First lieutenant Ordnance	Assistant professor of ethics and law.
John P. Story, Jr.	First lieutenant Fourth Artillery ..	Assistant professor of mathematics.
Edward H. Totten	First lieutenant First Artillery ..	Assistant professor of drawing.
George G. Greenough	First lieutenant Fourth Artillery ..	Assistant professor of French.
Samuel M. Mills	First lieutenant Fifth Artillery ..	Assistant instructor of tactics.
Thomas H. Handbury	Captain Engineers	Acting assistant professor of engi- neering.
John C. Mallory	First lieutenant Engineers	Acting assistant professor of engi- neering.
John F. Stretch	First lieutenant Tenth Infantry ..	Assistant instructor of tactics.
William F. Reynolds, Jr.	First lieutenant First Artillery ..	Acting assistant professor of mathe- matics.
Sedgwick Pratt	First lieutenant Third Artillery ..	Acting assistant professor of draw- ing.
John M. K. Davis	First lieutenant First Artillery ..	Assistant instructor of tactics.
Thomas H. Barber	First lieutenant First Artillery ..	Assistant professor of French.
John E. Greer	Second lieutenant Ordnance	Acting assistant professor of mathe- matics.
Edgar W. Bass	First lieutenant Engineers	Acting assistant professor of phi- losophy.
Frank Heath	Second lieutenant Third Artillery ..	Acting assistant professor of mathe- matics.
David D. Johnson	Second lieutenant Fifth Artillery ..	Acting assistant professor of chem- istry, &c.
David S. Denison	Second lieutenant Fifth Artillery ..	Assistant professor of Spanish.
Samuel E. Tillman	First lieutenant Engineers	Assistant professor of chemistry, &c.
Daniel M. Taylor	Second lieutenant First Artillery ..	Acting assistant professor of French.
William P. Duvall	Second lieutenant Fifth Artillery ..	Acting assistant professor of mathe- matics.
Houry L. Harris	Second lieutenant First Artillery ..	Acting assistant professor of mathe- matics.
David A. Lyle	Second lieutenant Second Artillery ..	Acting assistant professor of phi- losophy.
Edward S. Holden	Second lieutenant Engineers	Assistant instructor of practical military engineering.

MEMBERS OF THE BOARD.

Appointed by the President.

General H. T. REID, (President,) Iowa.
Colonel JAMES L. SCUDDER, (Secretary,) Tennessee.
Rev. CHARLES HODGE, New Jersey.
Hon. LOUIS S. LOVELL, Michigan.
Rev. CHARLES W. ELIOT, LL. D., Massachusetts.
GEORGE A. THRUSTON, Maryland.
HENRY R. PIERSON, New York.

Appointed by the President of the Senate.

Hon. SIMON CAMERON, United States Senator from Pennsylvania.
Hon. ALEXANDER RAMSEY, United States Senator from Minnesota.

Appointed by the Speaker of the House of Representatives.

Hon. WILLIAM HOUGHTON, Representative from Michigan.
Hon. AARON A. SARGENT, Representative from California.
Hon. SAMUEL S. COX, Representative from New York.

EXTRACT FROM ACT OF CONGRESS APPROVED AUGUST 8, 1846, AMENDED BY ACTS OF
MARCH 16, 1868, AND FEBRUARY 21, 1870.

That the President be authorized to appoint a Board of Visitors to attend the annual examination of the Military Academy, whose duty it shall be to report to the Secretary of War, for the information of Congress, at the commencement of the next succeeding session, the actual state of the discipline, instruction, police, administration, fiscal affairs, and other concerns of the institution: *Provided*, That the whole number of visitors each year shall not exceed seven: *Provided further*, That no compensation shall be made to said members beyond the payment of their expenses for board and lodging while at the Military Academy, and an allowance not to exceed eight cents per mile, for traveling by the shortest mail-route from their respective homes to the Academy, and back to their homes. And in addition to the other members of the Board of Visitors to be appointed by the President, according to law, to attend the annual examination of cadets at the United States Military Academy, there shall be on every such board two Senators, to be designated by the Vice-President, or President, *pro tempore* of the Senate; and three members of the House of Representatives, to be designated by the Speaker of the House of Representatives; such designations respectively to be made at the session of Congress next preceding the time of such examination; and the Senators and Members so appointed shall make full report of their action as such visitors, with their views and recommendations in regard to the said Military Academy, within twenty days after the meeting of Congress, at the session next succeeding the time of their appointment.

REPORT OF THE BOARD OF VISITORS.

WEST POINT, *June, 1872.*

SIR: The Board of Visitors to the United States Military Academy, for 1872, has the honor to submit the following report upon "the actual state of the discipline, instruction, police, administration, fiscal affairs, and other concerns of the institution."

DISCIPLINE.

The discipline of the Academy has been excellent under the administration of the present superintendent and commandant, partly because of the good judgment and soldierly qualities of these officers, and partly because of the firm support which the War Department has wisely given to the superintendent and the academic board. The visitors believe that, while the discipline is strict and severe, as is essential in a military institution, it is also, in the main, just, and judiciously adapted to the ends in view.

The board cordially approve of the discontinuance, within the last two years, of the system of exacting from cadets pledges on oath or on honor with regard to their conduct. Such pledges are objectionable, as giving occasion for all sorts of demoralizing casuistry, and as being confessions of weakness on the part of the authorities which are singularly inadvisable in a military school.

In general, the visitors believe that the punishments used in the Academy are duly proportioned to the offenses for which they are inflicted; but they find the system of summary dismissal too severe to be made by regulation the only legal punishment for the offense of harassing or molesting new cadets, an offense which may have many degrees of heinousness. Excessive or unreasonable punishments give grounds for legitimate complaints, and do more harm than good to the discipline of any place of instruction. There are, it is true, means of avoiding the injustice which the literal enforcement of the regulation numbered 122 would not unfrequently cause; the superintendent may recommend to mercy a cadet who has committed an offense which is really venial; or the War Department or the President may modify the sentence imposed by regulation; but inasmuch as the bare existence of a regulation which is frequently disregarded is an evil in itself, and inasmuch as the interference of authorities outside of and above the Academy is to be deprecated as inevitably injurious to discipline, unless such interference is very rare and very judicious, the visitors respectfully suggest that there be added to Regulation 122 the phrase employed in several other regulations relating to offenses, namely: "or be otherwise less severely punished, according to the degree of his offense."

It has seemed to the Board of Visitors that some of the cadets needed to be reminded, by the precept and example of all their officers and teachers, that violence of speech is as unbecoming an officer and a gentleman as any other sort of brutality, and that it would be well to have it understood that in selecting young officers for duty at the Academy

the Department looks for men who are as quiet as they are firm, and as self-controlled as they are energetic.

By Regulation 174, as amended March 15, 1872, reveille is at 5 o'clock a. m. from June 1 to September 1, at 6 o'clock a. m. from November 1 to March 1, and at 5½ o'clock a. m. the rest of the year; the signal to extinguish lights being at 10 o'clock p. m. during the whole year. The great majority of the cadets go to bed again after reveille and the first inspection of rooms, and get from an hour and a half to three-quarters of an hour of stolen sleep. This violation of the regulation has been winked at for many years, because the young men actually need more sleep than the regulation gives them. The visitors respectfully suggest that the regulation be so changed as to allow every cadet at least eight hours of unbroken sleep at all seasons of the year.

The best medical opinion is opposed to the use of the eyes in reading or study immediately after waking and before breakfast, and to violent exercise of any sort before breakfast. In deference to this opinion the Board suggests that the hour of breakfast should be placed as soon as practicable after reveille.

INSTRUCTION.

Terms of admission.—The character of a school is greatly influenced by the quality of the young persons who are admitted to its lowest class, and the requisitions for admission go far to determine this quality. The Military Academy is very disadvantageously situated in this regard; its requisitions for admission are by no means as high as those of the leading scientific and polytechnic schools of the country; indeed, there are many high schools and academies which demand more for admission than is demanded at West Point. The average age of the candidates for admission is eighteen years and eleven months, (see Appendix I,) but these adult men are only examined in reading, writing, arithmetic, English grammar, and the elements of geography and American history. Many boys of twelve could sustain the examination with ease. During the past five years the number of rejections for incompetency, at even this admission examination, has been from 20 to 50 per cent. of the whole number of applicants, in spite of the fact that the candidates have recently had notice of their provisional appointments several months before the examination. The professors and instructors who deal with the lowest class of the Academy, testify that they have to teach the greater part of the class how to study. Much time is necessarily devoted to this preliminary training.

Opinions may differ as to the real causes of this very low intellectual condition of the majority of the young men who gain admission to West Point, or as to the inevitableness of this condition of things, but as to the fact there can be no dispute. It is a fact which affects the whole course of study at the Academy, and it is necessary that an examining board should bear it constantly in mind, or they will be liable to do injustice to the teachers and the methods of the Academy.

The reason for keeping the requisitions for admission to West Point low, is that there are parts of the country in which a poor man's son can get no instruction in any but the most elementary subjects. This argument, though reasonable within certain limits, need not be pushed to the extreme of allowing the most ignorant State or Territory to set the standard for all the rest of the country. Five years ago the requisites for admission were increased by adding "a knowledge of the elements of English grammar, of descriptive geography, particularly of our own

country, and of the history of the United States," to the earlier requisites, which were simply reading, writing, and arithmetic. It is never wise to make sudden changes of great amount in the requisites for admission to an educational institution. The Board of Visitors, therefore, while it joins the many preceding boards which have reported upon this subject in deploring the present low standard of admission, would only recommend that the standard be raised in a slow way by successive small steps. One step would be the addition to the requisitions of a portion of elementary algebra, namely, the ground rules, fractions, and simple equations; a second step would be the addition of quadratic equations to this first requisition of algebra; a third step would be the addition of plane geometry.

It is in the power of the academic board to make much or little of the requisitions actually prescribed by Congress. The visitors observed, with satisfaction, that it was the purpose of the academic board to make the admission examination searching and effective within its very limited range.

It is a legitimate and wholesome effect of a national school, to which admission is obtained through a well-conducted examination of reasonable range, that it stimulates, and to some extent regulates, the lower schools of the country. The lower schools, both public and private, exert themselves to fit boys well for such examinations. Every boy who succeeds in passing creditably the Government examination, wins a prize for the school which fitted him, as well as for himself. The strong effect of the college examinations for admission upon the preparatory schools and academies of the country illustrates this principle.

With their present requisitions for admission, the Military and Naval Academies of the United States can have no stimulating effect on any school in the country above a primary school.

The Board of Visitors respectfully commend this important subject of the terms of admission to the consideration of the Department; they feel that the future welfare of the Academy depends largely upon the wise solution of this problem. The Academy must keep up with the general educational progress of the country; its raw material will go far to determine the nature of its product.

Course of instruction.—The great merit of the course of instruction and discipline at West Point, taken as a whole, is, that it cultivates, in an eminent degree, the virtues of obedience and self-denial, the sentiment of honor, and the sense of duty. The next conspicuous merit of the Academy is the thoroughness with which all the instruction is given, both in the theoretical and practical branches. In the theoretical studies this thoroughness is obtained at the sacrifice of range and variety, but under the peculiar circumstances of the Academy this sacrifice is wise. It is a third merit of the Academy that it sends out lieutenants who are competent to command in all three arms of the service; they have learned the duties of a soldier in the artillery, cavalry, and infantry. This is not the system of European military schools, but it is, nevertheless, a system singularly well adapted to the peculiar needs of the people and Government of the United States. The Board of Visitors desires thus to express its hearty recognition of these conspicuous merits of the Military Academy before it makes any criticisms upon the course of instruction, or indicates the points at which improvements seem possible.

The visitors are decidedly of the opinion that the study of Spanish should be discontinued, and that the time now allotted to Spanish should be given to French. The argument which caused the introduction of

Spanish into the course was, that we border upon a people who speak Spanish, and have many relations with the South American Spanish-speaking nations. The arguments which determine the opinion of the Board of Visitors are, first, that, as there is not time for the cadets to learn two foreign languages well, French is vastly the best language for them to study, because it is still the most available language for communication with foreigners, and because it has a very important military literature, which Spanish has not; secondly, that the mental training obtained by studying one language thoroughly is more valuable than that gained in getting a smattering of two languages; thirdly, that, as a matter of fact, the cadets can get only a very slight acquaintance with Spanish in the short time allotted to that study; there is no possibility of teaching them to speak or write the language, and the little they learn of it must soon be forgotten by the great majority of the cadets.

If this recommendation of the Board of Visitors should be adopted, French would be studied every day for two years. A substantial knowledge of the language can be gained in that time, even by young men who have had no other linguistic training. At the end of the second year, however, French is absolutely dropped, according to the present programme of studies. In order to keep up the knowledge of the language once acquired, the visitors recommend that a French text-book be used in some important department, both in the third and fourth year of the course.

The Board of Visitors, like many preceding boards, has remarked among the cadets a lack of ease and precision in the use of English. Rhetoric is not studied, and there are no exercises in English composition. Under the existing terms of admission, the graduate of the Military Academy may never have received any adequate instruction in the use of his native language. In addition to what he has been taught at the Academy itself, the graduate of the Academy is only expected to know what is taught in primary schools or in the lower classes of grammar schools. If he knows anything else, he has gone beyond the official requirements. In this condition of things the board recommends that in the event of the time allotted to French being increased by the suppression of Spanish, the department of French be instructed to require of the cadets frequent written translations from French into English, and to exact careful attention to the correctness and elegance of the English, and to neatness of penmanship.

The visitors think better of such exercises than of English compositions, believing that it is a vicious practice for young men to write upon subjects about which they really have no ideas. The Board of Visitors further recommends the vigorous and incessant enforcement of accuracy of language and distinctness of enunciation on the part of the cadets at all the ordinary recitations.

The board respectfully reports to the Department that the equipment of the departments of natural philosophy and chemistry is wholly inadequate, and that the mode of teaching in both these departments needs reconsideration and modification. Under the existing programme of studies, the cadet spends one-half of all the time he has for study, in the first two years of his course, upon the mathematics. The professor of mathematics is a man of great ability, force, and experience, and he comes in contact with every cadet every week for two years from his first entrance into the Academy. Under these circumstances the mode of teaching and the mode of recitation in all their details, including the use of the chalk and pointer at the blackboard, which are prescribed, and wisely pre-

scribed, in the mathematical department, are carried into the teaching of the sciences of observation and experiment, where they are by no means so appropriate. There is a peculiar discipline to be got from the proper study of chemistry, mineralogy, acoustics, optics, and electricity, a discipline which is not like the discipline to be derived from mathematics, and it is that peculiar discipline which the cadets should get from these studies; for chemistry and physics, when taught with book and blackboard, as if they were mathematics, are not as useful for training as the mathematics themselves. Indeed, it would be hard to contrive a more unprofitable and odious employment for the mind than committing to memory the facts of chemistry out of a manual. To commit a Latin grammar to memory would be better training, and more useful in every point of view. In order that chemistry and physics should yield to the student's mind their own peculiar fruits, they must be studied by observation and experiment on the part of the student. Only in this way can he acquire any just conceptions of the processes, methods, and results of these sciences. The student must handle the tools himself and observe for himself. If the bare facts of chemistry and physics are unprofitable husks, the theories and hypotheses of those sciences are not much better mental food when separated from the experimental data on which they rest. Indeed, when an inexperienced and defenseless student has a physical theory or speculation impressed on his mind by authority, as if it were a natural fact, he suffers a mental injury, which is always serious and sometimes irreparable. These views concerning the right mode of teaching the natural and physical sciences are by no means new. They are admitted in the practice of the best scientific schools and colleges. In order to equip working laboratories in chemistry and physics, it would be necessary to spend a moderate sum, say \$5,000, in each department, in providing the necessary fixtures and apparatus. Several excellent examples of such working laboratories may be found among the private incorporated colleges and polytechnic schools of the country.

It is, moreover, very desirable that the collections of illustrative apparatus in chemistry and physics should be gradually increased. A moderate annual appropriation in each department would be better than a large sum in one year and nothing in succeeding years.

While they make these suggestions about the mode of teaching chemistry and physics, the Board of Visitors do not mean to cast any imputation upon the efficiency of the excellent professors in these departments, and they desire expressly to guard against the possible inference that they would like to have more time devoted to these sciences. The board is of opinion that enough time is allotted to these subjects; they only suggest a different use of the time now given to them.

The thought that it will be hard to find young Army officers, graduates at West Point, who would be competent laboratory assistants to the accomplished professors of chemistry and natural philosophy, in giving the new kind of instruction suggested, brings into view a general difficulty in the organization of the Academy which well deserves the attention of the Department. All the instructors at West Point, apart from the professors, are young graduates of the Academy, who, after a few years of service on the frontier or on the sea-board, come back to West Point to act as teachers for four or five years under the active supervision of the professors. These young men have had the West Point training, and, as a rule, no other systematic instruction. Being under the orders of the permanent professors, they cannot strike out new ways of their own, even if they should devise any, which is highly improbable.

They have no opportunity of enlarging their experience and increasing their knowledge and skill by studying at universities or special schools, either of this country or Europe. In short, the Military Academy breeds in-and-in. The inherent conservatism of the system is only intensified by the frequency with which the superintendent and commandant are changed. The Board of Visitors content themselves with calling the attention of the Department to this danger, which they feel to be a grave one.

The three departments of mathematics, natural and experimental philosophy, (which includes mechanics,) and military and civil engineering, form, in some important respects, a sequence or progression. It is important that the several subjects which constitute this series should occupy the proper proportion of time, and that the transition from one subject to the next higher should be made at the right moment, and without waste by unnecessary repetitions in one department of what has really been taught in another. The board has received the impression that some time might be saved in the last two years of the course if the relations of the three departments above mentioned should be thoroughly re-examined by the Academic Board, and they believe that the present is a propitious time for such revision, because two young professors have lately been appointed, who would bring fresh minds to the work. The professorship of military and civil engineering is greatly overloaded. One professor, however able, is insufficient for such a wide range of both theoretical and practical knowledge, particularly as the same professor is called upon to give all the instruction in grand tactics, strategy, and the art of war. It is greatly to be desired that military and civil engineering should be separated and a professorship be established for each subject; but so long as the requisitions for admission remain at their present deplorably low level this improvement cannot well be made, because the course is full, and the cadets now give as much time to the general subject of engineering as can fairly be claimed for it, with due regard to the other equally pressing demands upon their attention.

At present the instruction given at the Academy in applied mechanics and engineering is necessarily elementary and incomplete. There are several scientific and polytechnic schools in the country in which much ampler courses of instruction in applied mechanics and civil, topographical, and mechanical engineering are provided than are given at West Point, or can be given there, so long as the starting-point of the Academy remains what it is.

The drawings made by the several classes at the Academy were carefully inspected by the Board of Visitors. The free-hand drawings prove that a certain number of the cadets are capable of learning to use the pencil, pen, and brush with skill, but that for the majority of the cadets the time spent in free-hand drawing is wasted, in spite of the assiduity and genius of the professor of drawing. With the greater number of his pupils, neither the eye nor the hand can be trained. The attention paid to mechanical drawing, taking the whole course through, seemed insufficient. The general mechanical execution of the last drawing made by the first class—a drawing of a half front of fortifications, with dry ditches and horizontal site—was not very creditable. In view of these facts, the board ventures to suggest that the drawing of the second year (third class) be confined to lettering, plotting, perspective, shades and shadows, topography, and other kinds of mechanical drawing, and that the drawing of the third year (second class) be dispensed

with as a required exercise. To fill the void thus made, the board further ventures to suggest that each cadet be required to study some one of the following subjects: free-hand drawing, chemistry, (laboratory work,) experimental philosophy, (laboratory work,) or French, the value to be given in either subject, in forming the merit roll, being 100. The cadets would probably choose with reference to their own tastes and capacities. This measure would give a chance of training assistant instructors in those four departments who would have attainments somewhat beyond the ordinary requirements.

The board were surprised to find that several weeks of the second year (third class) were devoted to ordinary penmanship, at the expense of drawing. In the opinion of the board, a fair handwriting ought to be insisted upon at the admission examination, and no time should be given, in the programme of studies at the Academy, to the practice of penmanship.

The cadets get but very little practice in the use of surveying-instruments. In the opinion of the board, more time might wisely be devoted to field-work in surveying and leveling. The actual use of the instruments gives excellent training of eye and hand, and the theory of the subject is made familiar by practical applications.

The observatory of the Academy is not in working order. The domes, shutters, and other appurtenances are out of repair; the equatorial is an old instrument, and is not in good condition; and certain alterations in the building have rendered it less fit than it originally was for the use of an observatory. If the Government proposes to maintain at West Point an astronomical observatory as a station for scientific labor, a liberal appropriation for building and equipping a new observatory will be necessary, and thereafter an annual appropriation for defraying the expenses of incessant observation. If, on the other hand, the Government simply desires to fit a few engineers every year for work upon the surveys which are likely to be in progress for many years to come in this country, a moderate expenditure upon the present observatory would make it an available though not a convenient place of practice in the common astronomical and geodetical observations. With the present programme of instruction in the Academy, it is impossible to give the cadets any practical instruction either in astronomy or geodesy, and the board does not perceive that the observatory has any direct function in regard to the cadets.

In all the departments of instruction in the Academy a great deal of time is given to reviews or repetitions as the cost of thoroughness. This fact is well illustrated by the following figures obtained from the three leading departments:

Mathematics.

Fourth class.	Algebra—57 lessons in advance, 47 in review during the year.	
	Geometry	Best section, 28 lessons in advance, 27 in review during the year.
		Worst section, 39 lessons in advance, 37 in review during the year.
	Trigonometry.	Best section, 15 lessons in advance, 12 in review during the year.
		Worst section, 18 lessons in advance, 16 in review during the year.
	Descriptive geometry.	Best section, 24 lessons in advance, 21 in review during the year.
		Worst section, 9 lessons in advance, 8 in review during the year.

Third class.	{	Analytical geometry.	{ Best section, 41 lessons in advance, 47 in review.
		Descriptive geometry.	{ Worst section, 32 lessons in advance, 36 in review.
	{	Best section, 14 lessons in advance, 16 in review.	
		Worst section 26 lessons in advance, 25 in review.	
	{	Diff. and integ. calculus.	{ Best section, 36 lessons in advance, 34 in review.
			{ Worst section, 33 lessons in advance, 31 in review.
	{	Surveying	{ Best section, 14 lessons in advance, 9 in review.
	{	Right-line drawing—18 days.	{ Worst section, 15 lessons in advance, 13 in review.

Natural philosophy.

Second class.	{	Mechanics—55 lessons in advance, 61 in review, 6 to 8 lectures.
		Acoustics—8 lessons in advance, 6 in review, 1 to 2 lectures.
		Optics—16 lessons in advance, 13 in review, 4 to 6 lectures.
		Astronomy—30 lessons in advance, 31 in review, 2 to 4 lectures.

Military and civil engineering.

First class.	{	Fortification and stone-cutting—9 lessons in advance, 5 in review.
		Civil engineering—34 lessons in advance, 36 in review.
		Field-works—20 lessons in advance, 14 in review,
		Permanent works—17 lessons in advance, 10 in review.
		Outposts—art of war—15 lessons in advance, 9 in review.
		Drawing—24 days.
	{	Lectures—10 days.

Every class in the Academy is divided, for the recitations in each subject, according to proficiency in that subject. The sections into which each class is divided in each subject do not all accomplish the same amount of work. The poorest scholars pass over, in a somewhat inferior manner, from two-thirds to three-quarters of the ground covered by the best scholars. It is the custom to omit the hardest problems or passages of the text-book with the poorer sections. That the ratio of the attainments of the worst section to those of the best can be kept so high illustrates the efficiency of the means of compelling study which are in use at the Academy.

The Board of Visitors has been much impressed with the prominence which the merit-roll has in the minds of both teachers and cadets. It is an important function of the professors to teach the assistant instructors (who are constantly changing) how to "mark," and to watch the daily recitations of the cadets with a view to estimating accurately the true standing of each individual. The cadets are allowed to get their "marks" every week, and so to keep account of their own and each other's progress. Emulation is thus made constant and keen. Every cadet, therefore, whether a good scholar or bad, works under an intense external pressure.

The Board of Visitors feel some doubt as to the after effects of this system. The training given at West Point is but a good foundation, on which the young graduate must himself build, if he hopes to attain to any broad culture or any high professional skill. The visitors cannot but fear that the young graduate may miss the accustomed stimulus, and find nothing within himself to make good the loss of it. The fact that the permanent professors at West Point do not, as a rule, give instruction themselves, increases the difficulty now under discussion. Their time is mainly given to supervising the daily work of the assistant instructors, and hence it happens that the only experienced teachers at the Academy do not habitually and regularly instruct any portion of the cadets. Now, good teaching is largely a matter of personal skill and personal influence, and this skill and influence can very seldom be im-

parted to others by any amount of drilling. The cadets studying under this system have very little chance of catching inspiration from their teachers, and yet inspiration and enthusiasm are essential to any large success in any pure or applied science. The board regrets the practical diversion of the professors from the high function of daily teaching, but does not venture to give any advice concerning a remedy for this evil.

The board is not persuaded that the custom of making the ordinary recitations one hour and a half long, which has prevailed for many years at this Academy, is a wise one. The practice of the academic world is in favor of one-hour recitations. In Germany the ordinary length of a lecture is three-quarters of an hour. If the cadets attend closely during the hour and a half, the continuous strain is unreasonably long; if each attends only while he is himself at work, he wastes an hour or more during which he might be doing something profitable. The board is inclined to think that general experience would be a safe guide upon this point.

The visitors would suggest that the Academic Board might advantageously consider whether written examinations could not be substituted for oral throughout the Academy. The oral examinations which the board attended were rather exhibitions or specimens of recitations than examinations. The written examination applies the same test to all, and the written evidence of competency or incompetency remains behind. It is impossible to give much weight to a hasty oral examination, which, after all, is only a single recitation of five or ten minutes for each person examined. The very general adoption of the written mode of examination on all serious occasions, both in this country and Europe, seems to the Board of Visitors suggestive.

ADMINISTRATION.

The Board of Visitors took pains to inspect frequently and unexpectedly the cadets' mess. During their stay the mess-hall, kitchen, and store-rooms were neat and the food was good. The diet seemed judiciously selected, except in one respect, to which the board begs to call attention. The cadets are not allowed milk to drink. The board thinks that the cadets should be encouraged to use milk instead of strong tea and coffee, and advises that as much milk as they will consume be regularly provided morning and evening. In the opinion of the board, it is desirable that a more skillful cook and a better class of waiters should be employed for the mess.

The cadets' hospital seemed to the board entirely unsuitable—badly placed and badly constructed, and lacking light, ventilation, and drainage. The building would make good quarters for officers, which are much needed. The board recommends that a new hospital be built as soon as possible.

The houses on the western side of the plain, occupied by officers of the Academy, have no proper means of drainage. The board recommends that a sewer be constructed for them with a water-supply capable of keeping the sewer clean.

FISCAL AFFAIRS.

The Board of Visitors, through a committee of its number, examined the books and vouchers of the treasurer and quartermaster. The system of accounts is clear and comprehensive, so that the committee were

enabled readily to ascertain the amounts appropriated and the items of expenditure. The committee further examined the accounts kept by the treasurer with the cadets, and reported to the board that the accounts were kept with great care and with all necessary details.

The buildings and appointments of the Academy are adequate for a much larger number of cadets than are ever present. An increase in the number of cadets will therefore not entail a corresponding increase in the cost of maintaining the Academy. Under the new apportionment the size of the corps will be somewhat increased. The Board of Visitors believes that it would be for the interest of the country to have the Academy kept constantly full to the legal limit, and respectfully suggests that the Department use all means within its power to accomplish this end.

In conclusion, the visitors beg leave to say that they have attended to the duty imposed upon them with a satisfaction qualified only by a sense of the inadequacy of the inspection which they have been able to make, and of their unfitness for the task. A thorough inspection of a place of instruction can only be made when the regular work is going on. The annual visit to West Point is inevitably somewhat of a "show" occasion, when the ordinary routine of the Academy is interrupted. The members of the Board of Visitors received every facility and many courtesies from the officers of the Academy, for all of which they beg to return their sincere acknowledgments.

Their brief study of the institution has quickened their pride in its honorable past and their zeal for its improvement and growth in the future. Gratitude, pride, and prudence should all impel the nation to cherish the Military Academy at West Point.

H. T. REID, of Iowa,

President of the Board.

JAMES L. SCUDDER, of Tennessee,

Secretary of the Board.

CHARLES HODGE, of New Jersey.

CHARLES W. ELIOT, of Massachusetts.

GEORGE A. THRUSTON, of Maryland.

LOUIS L. LOVELL, of Michigan.

H. R. PIERSON, of New York.

SIMON CAMERON, of Pennsylvania.

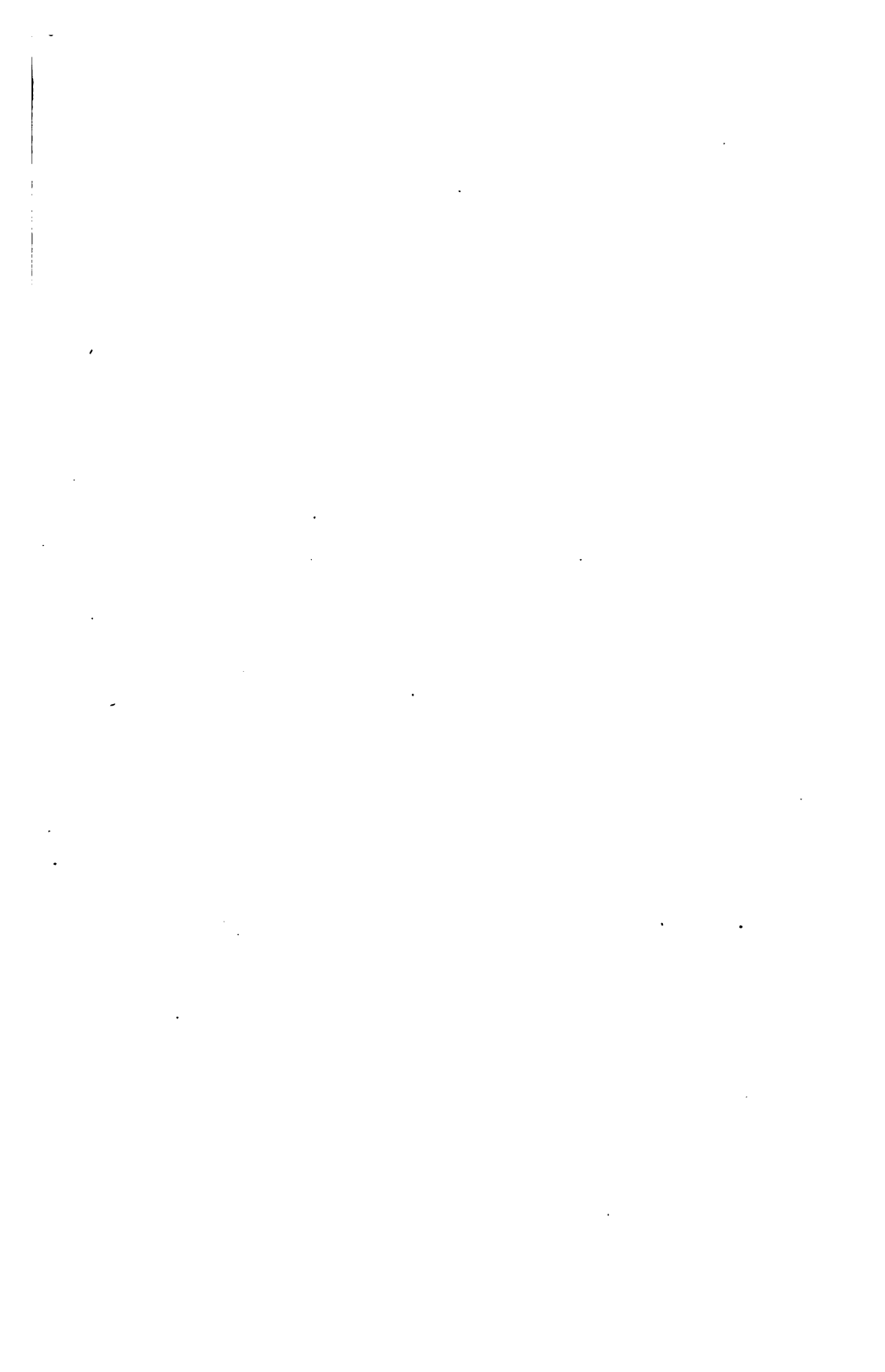
ALEX. RAMSEY, of Minnesota.

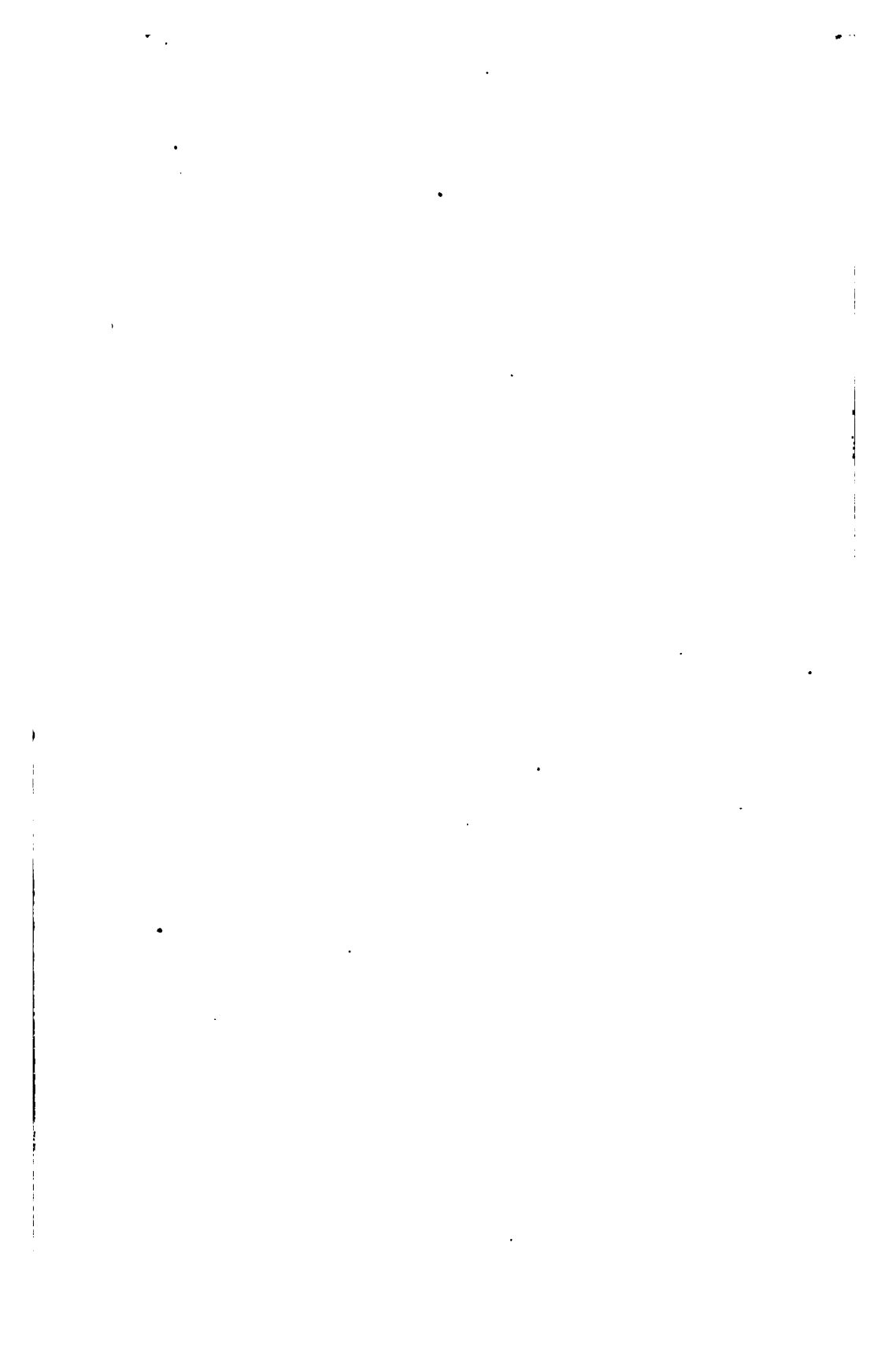
WILLIAM L. STOUGHTON, of Michigan.

AARON A. SARGENT, of California.

Hon. WM. W. BELKNAP,

Secretary of War.





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